

DIVISION OF ENVIRONMENT
QUALITY MANAGEMENT PLAN

PART III:

STREAM CHEMISTRY MONITORING PROGRAM
QUALITY ASSURANCE MANAGEMENT PLAN

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TABLE OF CONTENTS

<u>Section</u>	<u>Revision No.</u>	<u>Date</u>
1 INTRODUCTION		
1.1 Purpose of Document	0	12/01/00
1.2 Historical Background	0	12/01/00
1.3 Contemporary Program Objectives	0	12/01/00
2 QUALITY ASSURANCE GOALS AND EXPECTATIONS	0	12/01/00
3 QUALITY ASSURANCE ORGANIZATION		
3.1 Administrative Organization	0	12/01/00
3.2 Staff Responsibilities	0	12/01/00
3.3 Staff Qualifications and Training	0	12/01/00
4 QUALITY ASSURANCE PROCEDURES		
4.1 Monitoring Site Selection	0	12/01/00
4.2 Field Protocols		
4.2.1 Sample Collection	0	12/01/00
4.2.2 Sample Containers	0	12/01/00
4.2.3 Sample Preservation	0	12/01/00
4.2.4 Preliminary Measurements	0	12/01/00
4.3 Sample Transport, Chain-of-Custody and Holding Times ..	0	12/01/00
4.4 Laboratory Analytical Parameters and Procedures	0	12/01/00
4.5 Internal Procedures for Assessing Data Precision, Accuracy, Representativeness and Comparability		
4.5.1 In-house Audits	0	12/01/00
4.5.2 Instrument Calibration and Standardization	0	12/01/00
4.5.3 Field Blanks	0	12/01/00
4.5.4 Field Duplicate Samples and Spiked Samples	0	12/01/00
4.5.5 Preventative Maintenance	0	12/01/00
4.5.6 Safety Considerations	0	12/01/00
4.6 External Procedures for Assessing Data Precision, Accuracy, Representativeness and Comparability	0	12/01/00
4.7 Corrective Action Procedures for Out-of-Control Situations		
4.7.1 Equipment Malfunction	0	12/01/00
4.7.2 Sample Contamination	0	12/01/00
4.7.3 Data Precision/Accuracy Problems	0	12/01/00
4.7.4 Staff Performance Problems	0	12/01/00

<u>Section</u>	<u>Revision</u> <u>No.</u>	<u>Date</u>
4.8 Data Management		
4.8.1 General Data Management	0	12/01/00
4.8.2 Data Analysis Procedures	0	12/01/00
4.8.3 Data Entry Requirements	0	12/01/00
4.8.4 Verification of Calculations	0	12/01/00
4.8.5 Data Transformation, Outliers and Reporting Limits	0	12/01/00
4.8.6 Ancillary Data	0	12/01/00
4.9 Quality Assurance Reporting Procedures	0	12/01/00
4.10 Purchased Equipment and Supplies	0	12/01/00
4.11 Program Deliverables	0	12/01/00
5 REVIEW AND REVISION OF PLAN	0	12/01/00
APPENDIX A: FIELD EQUIPMENT AND SUPPLY CHECKLIST	0	12/01/00
APPENDIX B: STANDARD OPERATING PROCEDURES	0	12/01/00
APPENDIX C: STANDARDIZED FIELD SHEETS AND SAMPLE SUBMISSION FORMS	0	12/01/00
APPENDIX D: GLOSSARY OF TERMS	0	12/01/00
APPENDIX E: REFERENCES	0	12/01/00

Section 1

INTRODUCTION

1.1 Purpose of Document

This document presents the quality assurance (QA) management plan for the Kansas stream chemistry monitoring program. Quality assurance goals, expectations, organizational responsibilities, and program evaluation and reporting requirements are specifically addressed. Standard operating procedures (SOPs), describing sample collection, preservation, transport and analysis methods, equipment maintenance and calibration protocols, and other routine program activities, are provided in the appendices of the plan.

1.2 Historical Background

The Kansas Department of Health and Environment (KDHE) and its predecessor agency, the Kansas State Board of Health, have together monitored the quality of the state's streams and rivers for more than a century. Early monitoring efforts, from the middle 1890s to the early 1920s, focused primarily on the sanitary condition of waterbodies serving as public water supplies and on the incidence of the typhoid bacterium (*Salmonella typhi*) in drinking water. These efforts were instrumental in the passage of several major sanitation and water pollution control statutes and contributed to a dramatic reduction in the incidence of typhoid fever in Kansas.

Intensive river basin surveys were performed on an episodic basis from approximately 1922 to 1978. These surveys entailed a considerable commitment of staff and other resources. By 1978, individual surveys involved as many as twenty agency employees and fifteen field vehicles, including three mobile laboratory facilities. Employees remained in the field for eleven days at a time. Two days were required for laboratory set up and field reconnaissance and an additional two for laboratory take down, leaving seven consecutive days for field monitoring purposes. Staff were assigned specific sample collection and/or analytical duties. Sampling crews were dispatched each morning from a central "field" location, normally a small hotel or a public park facility with electrical and water hook-ups for the mobile laboratories. Water samples were collected from several dozen streams within the basin. Also, samples of treated wastewater were gathered from discharging sewage treatment plants, and semi-quantitative studies of benthic macroinvertebrate communities were performed at the stream chemistry monitoring locations (see stream biological program QA management plan).

Water and wastewater samples collected during the basin surveys were transported to the mobile laboratory facilities near the middle of each work day and analyzed for total suspended solids, total hardness, pH, total and phenolphthalein alkalinity, calcium, magnesium, biochemical oxygen demand (BOD), dissolved oxygen (DO), chloride, and total coliform, fecal coliform and fecal streptococcus bacteria. Additional samples were preserved in the field and ultimately transported

to the KDHE environmental laboratory in Topeka, where they were analyzed for turbidity, specific conductance, nutrients (ammonia, nitrate, total phosphorus), selected alkaline earth and alkali metals (sodium, potassium, magnesium, barium), selected transition metals and metalloids (total recoverable arsenic, cadmium, copper, iron, manganese, mercury, selenium, silver and zinc and hexavalent chromium), polychlorinated biphenyls, phenols, and selected pesticides and pesticide degradation products (e.g., 2,4-D, 2,4,5-T, 2,4,5-TP, aldrin, alpha-BHC, atrazine, dacthal, DDE, DDT, dieldrin, endrin, heptachlor, heptachlorepoxyde, lindane, methoxychlor, sencor, toxaphene).

From 1956 to 1961, the Kansas State Board of Health also collected water samples on a monthly basis from a network of 39 "permanent" stream monitoring stations. Almost all of these stations were located on major rivers, and many were located immediately downstream of large federal reservoirs. Grab samples were collected from bridges and analyzed for most of the inorganic parameters mentioned previously. In 1961, the agency entered into a cooperative agreement with the United States Geological Survey (USGS), an agency which had independently conducted water quality monitoring in the state from 1945 to 1960. This agreement created a joint state/federal network consisting of 67 monitoring stations. The terms of the agreement were such that most analytical work was conducted by the Kansas State Board of Health, whereas most field work and report writing activities were conducted by USGS. This cooperative program continued to evolve over the next decade. In 1967, approximately 35 "interstate" monitoring stations were added to the network and sampled on a bimonthly basis for most routine inorganic and bacteriological parameters. Approximately 37 "interior" monitoring stations were added to the network in 1973. Samples were collected from these stations on a monthly basis and analyzed for most of the inorganic, organic and bacteriological parameters mentioned previously.

The Kansas stream chemistry monitoring program underwent several major changes in October 1975. Specifically, the cooperative agreement with USGS was discontinued; all sample collection and analysis activities and data interpretation/report writing functions were transferred to KDHE; the number of monitoring stations in the network was reduced from approximately 140 to 115; and the collection of transition metal and pesticide samples was implemented at all stations. The monitoring program continued with essentially no further modification until April 1990. At that time, the number of permanent monitoring sites in the network increased to 148 and samples began to be collected on a bimonthly (rather than monthly) schedule. Nearly 140 "rotational" monitoring stations also were added to the sampling network. Water samples were collected from a given rotational station only one year out of every four years (i.e., about one-fourth the total number of rotational sites were sampled, on a bimonthly basis, in any given year). In all, approximately 175 monitoring stations, permanent and rotational, were sampled in any given year. The addition of these new stations in 1990 allowed the agency to obtain a much broader geographical perspective on water quality conditions within the state (see Figure 1.2-1). Also, the placement of many of these stations on smaller order streams facilitated a more thorough analysis of rural and agricultural impacts on surface water quality.

From 1990 to 1995, several additional parameters were added to the list of monitored substances. Examples included fluoride, nitrite, ortho-phosphate, antimony, molybdenum and thallium. This expansion in the number of parameters was made possible through the procurement of new analytical instrumentation by the KDHE laboratory (KHEL). Examples of such instrumentation included an ion chromatograph, an intercoupled argon plasma emission spectrometer, and more sophisticated gas chromatographs and mass spectrometers. The microbiological parameters, fecal coliform bacteria and fecal streptococcus bacteria, were monitored at all permanent and rotational stations.

From 1995 to 2000, the inclusion of additional ecoregional reference sites and watershed integrator sites increased the number of permanent monitoring stations in the network to 158. The number of rotational sites increased to 148, primarily to accommodate the ongoing development and implementation of total maximum daily loads (TMDLs). These TMDL activities, and the Governor's Water Quality Initiative (1996-1998) and several other special studies, required more frequent (biweekly or monthly) collection of samples from selected sites around the state. The addition of two chemical parameters (Kjeldahl nitrogen and total organic carbon) and the discontinuation of one microbiological parameter (fecal streptococcus bacteria) are changes that have occurred in the program in the last two years (see section 4.4). Currently, the stream chemistry monitoring network is comprised of 304 permanent and rotational sites (Figure 1.2-1).

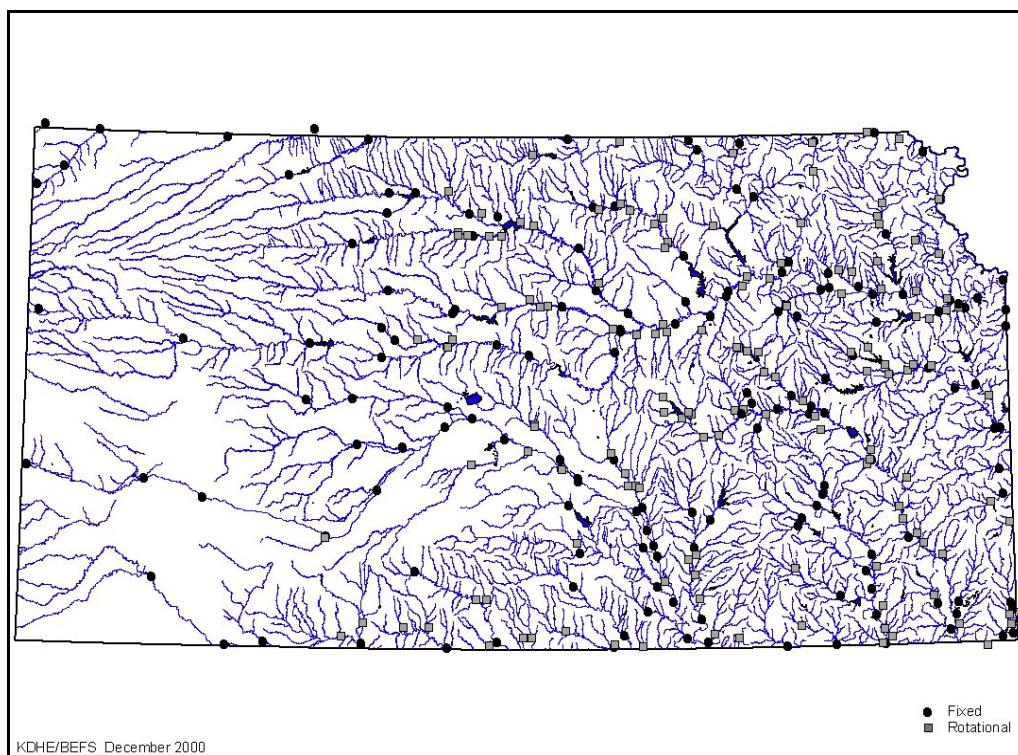


Figure 1.2-1. Current distribution of permanent and rotational stream chemistry monitoring stations.

1.3 Contemporary Program Objectives

The stream chemistry monitoring program endeavors to provide timely and scientifically defensible information on the physical, chemical and bacteriological condition of flowing waters in Kansas. This information is intended for use in:

- (1) complying with the water quality monitoring and reporting requirements of 40 CFR 130.4 and sections 106(e)(1), 303(d) and 305(b) of the federal Clean Water Act;
- (2) evaluating waterbody compliance with the provisions of the Kansas surface water quality standards (K.A.R. 28-16-28b *et seq.*);
- (3) identifying point and nonpoint sources of pollution contributing most significantly to documented water use impairments;
- (4) documenting spatial and temporal trends in surface water quality resulting from changes in prevailing climatological conditions, land use and land cover, natural resource management practices, wastewater treatment plant operations, and other phenomena;
- (5) developing scientifically defensible environmental standards, wastewater treatment plant permits, and waterbody/watershed pollution control plans and TMDLs; and
- (6) evaluating the effectiveness of pollution control efforts and waterbody remediation/restoration initiatives implemented by the department and other natural resource agencies and organizations.

Section 2

QUALITY ASSURANCE GOALS AND EXPECTATIONS

The foremost goal of this QA management plan is to ensure that the Kansas stream chemistry monitoring program produces data of known and acceptable quality. "Known quality" means that data precision, accuracy, completeness, comparability and representativeness are documented to the fullest practicable extent. "Acceptable" means that the data support, in a scientifically defensible manner, the informational needs and regulatory functions of the Bureau of Environmental Field Services (BEFS), the Division of Environment, and the agency. The success of the program in meeting this general goal is judged on the basis of the following data performance criteria and requirements:

- (1) Where practicable, the reliability of program data shall be documented in a quantitative fashion. For routine water chemistry parameters, the precision of data shall be evaluated through the use of duplicate samples and the accuracy of data shall be evaluated through the use of field blanks and spiked samples. The average coefficient of variation among duplicate samples shall, for all parameters, be less than twenty percent; spike recoveries shall average between 80 and 120 percent of the actual spike concentrations; background contaminant levels (determined through the analysis of field blanks) shall constitute, on average, less than ten percent of the reported sample concentrations.
- (2) Loss of physicochemical and microbiological data due to sample collection, transport or analytical problems, or to the subsequent mishandling of data, shall be limited to less than five percent of the data originally scheduled for generation. Where problems occur and a substantial quantity of data is lost, an effort shall be made to resample the effected stream(s) to maximize data completeness.
- (3) Changes in the methods used to obtain and analyze surface water quality samples shall be carefully documented through formal revisions to the standard operating procedures (SOPs) appended to this QA management plan. This requirement is intended to help maintain a reasonably consistent database over time, enhance knowledge of the effects of any procedural changes on reported contaminant concentrations, and facilitate the identification and evaluation of long-term trends in surface water quality.
- (4) Data generated through this program shall be compared and contrasted with other available monitoring data to examine the representativeness of program findings relative to other reported results. Staff shall attempt to ascertain the probable causes of any discrepancies observed between the various existing databases and describe, in end-of-year program reports, the magnitude and practical significance of such discrepancies.

Section 3

QUALITY ASSURANCE ORGANIZATION

3.1 Administrative Organization

The stream chemistry monitoring program is one of several statewide environmental monitoring programs administered by the Technical Services Section, Bureau of Environmental Field Services (see QMP, Part II, BEFS QA Management Plan). Program offices are located at Forbes Field in Topeka, Kansas.

3.2 Staff Responsibilities

Program staff include one environmental scientist and one environmental technician, both affiliated with the BEFS Technical Services Section. The environmental scientist serves as the program manager and is accountable for most program planning, data interpretation, and report writing activities. This employee also monitors program QC, appraises the section chief of any equipment needs or staff training needs, and participates in the annual review and revision of the program QA management plan (see section 5).

The environmental technician is responsible for most day-to-day field activities, including nearly all sample collection, preservation, transport and chain-of-custody (sample documentation) functions. Other duties include the routine maintenance of field equipment, the scheduling of laboratory services, and the review and verification of laboratory data prior to transfer to the Kansas Water Database and United States Environmental Protection Agency (EPA) STORET database (section 4.8). Staff of the BEFS Northwest District Office (operating out of Hays, Kansas) and the Southwest District Office (operating out of Dodge City, Kansas) also participate in the program by collecting samples from streams in the westernmost region of the state (Appendix B). Occasionally, personnel from other BEFS programs may assist with stream chemistry sampling activities, especially in the event of staff absences or when additional people are needed to conduct work in a timely, safe and efficient fashion. Staff of the stream chemistry monitoring program provide reciprocal assistance to these other programs.

3.3 Staff Qualifications and Training

Minimum technical qualifications for program staff vary by position. The program manager must hold at least a four-year college degree in environmental chemistry, environmental microbiology, aquatic biology, hydrology or a related scientific field and have substantial experience in the performance of water quality studies and associated data analysis and statistical procedures. The program manager must also understand the basic principles of supervision, program administration and quality control and possess advanced computer skills and written and oral communication skills. Also, pursuant to Part I of the divisional quality management plan (QMP), the program manager must complete formal supervisory training offered by the Kansas Department of Administration and

quality assurance training offered by EPA. The program's environmental technician III (and all other employees routinely assisting with this program) must command a thorough understanding of the procedures used in the collection, handling and preliminary analysis of surface water samples and in the processing of associated paperwork and other documentation. The environmental technician III travels extensively throughout the state, observing and obtaining samples from literally hundreds of streams. Hence, this individual performs a valuable reconnaissance function and must be proficient in the visual identification and recognition of severe water quality problems warranting follow-up investigation and/or an emergency remedial response.

Individuals routinely participating in this program must possess a valid Kansas driver's license and current certifications in first aid and cardiopulmonary resuscitation (CPR). They must review the program's QA management plan and SOPs prior to assuming field/laboratory duties and repeat this review at least annually (QMP, Part I). All program staff receive in-house training in applicable work procedures and related safety requirements. As funding and other agency resources allow, the program manager and the environmental technician III are encouraged to participate in technical workshops and seminars dealing with environmental monitoring operations and related field, analytical, data management and statistical procedures.

Section 4

QUALITY ASSURANCE PROCEDURES

4.1 Monitoring Site Selection

The monitoring program's network of permanent and rotational stations is designed around the objectives set forth in section 1.3 of this document. Specifically, an effort is made to evaluate water quality conditions in each of the state's major physiographic, geological and land use regions (objectives 1, 2 and 4) while providing data on individual waterbodies needed to identify major sources of contaminants (objective 3), develop scientifically defensible permits, pollution control plans and/or TMDLs (objective 4), and assess the effectiveness of implemented pollution control and remediation efforts (objective 6). In selecting individual stations for inclusion (or retention) in the monitoring network, the following questions are posed:

- (1) Would the candidate station materially enhance the spatial coverage of the monitoring network? That is, would the location coincide with a region of the state or a major river basin currently under represented in the network?
- (2) Would the candidate station reflect water quality conditions throughout the entire watershed or stream segment, or would local phenomena (e.g., channelization projects, point sources, area cropping practices, livestock access, riparian deforestation) create water quality conditions unrepresentative of the watershed or stream segment as a whole?
- (3) Would the candidate station afford long-term access to the stream for monitoring purposes? Could access be curtailed at the discretion of a private landowner or limited during periods of heavy precipitation and/or high stream flow?
- (4) Does historical water quality data exist for the candidate site? If so, does the available database provide a reliable indication of historical water quality conditions?
- (5) Does other, ancillary data exist for the candidate site? Does the site coincide with any ongoing hydrological or biological data collection activities (e.g., KDHE stream biological monitoring station; USGS stream gaging station)?
- (6) Would the candidate station provide water quality data of unique interest? For example, does the site represent an unusually pristine location, suitable for use as a long-term ecoregional reference location? Does the stream segment constitute an outstanding natural resource water or a critical habitat for any state or federally listed threatened or endangered species? Is the candidate site located on an interstate stream in the vicinity of the state boundary, thereby constituting a potential interstate stream monitoring station?

Temporary monitoring stations also may be added to the network to support special studies conducted by KDHE or other cooperating agencies. Participation in such studies is ultimately contingent on the availability of staff and other resources. All monitoring stations, whether temporary, rotational or permanent, are subject to the same site documentation requirements: longitude and latitude are precisely determined through the use of global positioning system (GPS) techniques (see SOP No. SCMP-001); photographs are taken of all monitoring locations and periodically updated to track changes in the physical character of the monitoring sites; and narrative descriptions of the monitoring locations are prepared and maintained on a computer database to facilitate site identification/verification by new monitoring personnel and interested members of the general public.

4.2 Field Protocols

4.2.1 Sample Collection

The Kansas stream chemistry monitoring network is conveniently divided into eight sampling routes or "runs." Program personnel perform one run each week, or the entire set of runs every two months, thereby accommodating the bimonthly sampling schedule described in section 1.2. Three of the runs are limited in extent to northeastern Kansas and are completed in a single day. The five remaining runs, which cover larger expanses of land and are farther removed from Topeka, require three days to complete. Program staff work closely with KHEL analysts to schedule sampling runs well ahead of time and ensure that the laboratory is prepared to receive incoming samples. Typically, staff inform KHEL of analytical needs at least two months in advance of a sampling run. Forms for recording field data and submitting samples to the laboratory are prepared at least one week before a sampling run, and the appropriate information is recorded on the forms during the course of the run (Appendix C).

A full-sized van with special safety accommodations is utilized for most field work (Appendix A). Upon arrival at a monitoring station, the van is parked on the shoulder or far side of the road (rural areas) or in a nearby parking lot (urban areas), hazard lights are engaged, and staff approach the bridge on foot wearing fluorescent orange safety vests or jackets. Water samples are collected from the comparative safety of the bridge deck with the aid of a rope and a specially fabricated weighted stainless-steel bucket or, in the case of pesticide or radiological samples, a stainless-steel pail. Samples are collected from the downstream side of the bridge and from the apparent thalweg (the deepest appearing portion of the channel) to minimize entanglement with debris and resuspension of sediment. All samples are transferred to the van, where preliminary measurements are performed and the samples are fractionated and preserved prior to delivery to KHEL (sections 4.2.2, 4.2.3 and 4.2.4).

Strict adherence to these sampling procedures may not always be possible due to safety considerations and varying field conditions (e.g., ice formation, woody debris accumulations, bridge repair work). If some improvisation is required in the collection of a particular sample, the procedures actually used to collect the sample must be documented on the field sheet under the remarks column (Appendix C).

4.2.2 Sample Containers

Several types of samples are actually gathered by program staff, and each is transported and stored in its own specific kind of container (Appendix B). After sample collection, the weighted stainless steel sample bucket is gently swirled between each of the poured fractions. The fraction reserved for mineral determinations is ultimately transferred to a one-quart plastic cubitainer; the aliquot reserved for heavy metal analysis is transferred to an acid-washed 175-ml Nalgene bottle; the aliquot reserved for the nutrient analysis is transferred to a 175-ml Nalgene bottle; the aliquot reserved for the bacterial analysis is transferred to an autoclaved 250-ml polyethylene bottle. The remaining portion of the sample provides water for pH and temperature measurements. Pesticide samples are transferred from the stainless steel pail to a one-gallon dark glass bottle with a Teflon-lined plastic cap. Radiological samples are transferred to a one-gallon polyethylene jug, except for the tritium sample fraction which is transferred to a 100-ml glass bottle.

4.2.3 Sample Preservation

Methods employed in the preservation of stream water samples are described in detail in Appendix B. In summary, mineral, nutrient, pesticide and bacteriological samples are stored in the dark, on ice, pending transfer to KHEL. Heavy metal sample bottles and radiological sample jugs supplied by KHEL are pre-acidified with nitric acid, whereas nutrient sample bottles require the addition of 1 ml of 1:30 (v/v) sulfuric acid upon transfer to the van. Dissolved oxygen samples are analyzed via the Winkler titration technique and are preserved in the van using appropriate additions of manganous sulfate, alkaline potassium iodide azide, and concentrated sulfuric acid (APHA 1992); once the sulfuric acid is added, the dissolved oxygen samples are stored in a deeply shaded area of the van pending transfer to KHEL (Appendix B).

4.2.4 Preliminary Measurements

Temperature is measured to the nearest °C using a Fisher model #15-0778 stainless-steel dial scale thermometer, which is placed directly in a 50-ml beaker following transfer of the sample to the field vehicle. pH measurements are performed on the same 50-ml sample aliquot using a Cole Parmer model #5996-70 portable pH meter or comparable instrument. All measurements are recorded on the field recording sheet along with other pertinent information (see Appendix B).

4.3 Sample Transport, Chain-of-Custody and Holding Times

All samples must be handled and stored in a fashion which minimizes contamination, leakage and damage during transport. Samples collected during one-day sampling runs are delivered to KHEL that same day, prior to the close of business. Samples gathered on three-day sampling runs are delivered to the laboratory on the last day of the sampling run, prior to the close of business. In the event field staff are unavoidably detained, every effort is made to contact KHEL by telephone to arrange for the late afternoon or evening transfer of samples. As a rule, no sample arrives at KHEL later than 72 hours after collection. Only those samples collected during three-day runs and submitted for DO, BOD, bacteria, nitrate, nitrite and/or ortho-phosphate analysis routinely exceed the maximum holding times established by KHEL. Quality control studies conducted by BEFS have

shown no short-term holding time effect for dissolved oxygen once the samples are acidified. However, reported concentrations of fecal coliform bacteria, BOD, nitrate, nitrite and ortho-phosphate may be somewhat less than actual ambient levels owing to bacteriological die-off, to microbial assimilation of phosphorus, nitrogen and dissolved oxygen, and to other processes occurring within the samples. The magnitude of any change in concentration is ascertained through the use of field spikes (section 4.5.3, below) and through special QC (time-course) studies conducted by BEFS and KHEL.

Standardized sample submission (chain-of-custody) forms accompany all samples submitted to KHEL (Appendix C). These forms identify sampling location, date and time of sample collection, personnel involved in the collection of the sample, and analytical parameters of interest. They also assign each sample a unique identification number for future reference. Staff involved with the collection and transfer of a sample sign and date the form and deliver it (with the sample) to KHEL. Staff of KHEL sign the form, and record the date and time on the form, to acknowledge receipt of the sample. This basic sign-off procedure also is performed if the sample changes hands prior to arrival at KHEL (e.g., when district staff transfer samples to program staff; see Appendix B).

4.4 Laboratory Analytical Parameters and Procedures

Analytical methods employed by KHEL and associated parameter reporting limits are summarized in tables 4.4-1 through 4.4-4, below.

TABLE 4.4-1

ROUTINE COMPOSITE AND INORGANIC CHEMICAL PARAMETERS

CONSTITUENT OR PHYSICAL PROPERTY	REPORTING LIMIT	REPORTING UNIT	ANALYTICAL METHOD	HOLDING TIME
Alkalinity, total (as CaCO ₃)	1	mg/L	EPA 310.2	14 days
Aluminum, total recoverable	0.05	mg/L	EPA 200.7	6 months
Ammonia, total (as N)	0.02	mg/L	EPA 350.1	28 days
Antimony, total recoverable	0.05	mg/L	EPA 200.7	6 months
Arsenic, total recoverable	1	μg/L	EPA 200.9	6 months
Barium, total recoverable	0.005	mg/L	EPA 200.7	6 months
Beryllium, total recoverable	0.001	mg/L	EPA 200.7	6 months
Biochemical oxygen demand	1	mg/L	APHA 5210B	24 hours
Boron, total recoverable	0.01	mg/L	EPA 200.7	6 months
Bromide	0.02	mg/L	EPA 300.0	28 days
Cadmium, total recoverable	1	μg/L	EPA 200.9	6 months

Calcium, total recoverable	0.05	mg/L	EPA 200.7	6 months
Chloride	0.01	mg/L	EPA 300.0	28 days
Chromium, total recoverable	1	μg/L	EPA 200.9	6 months
Cobalt, total recoverable	0.01	mg/L	EPA 200.7	6 months
Copper, total recoverable	1	μg/L	EPA 200.9	6 months
Dissolved oxygen	0.1	mg/L	EPA 360.1	Immediate
Fluoride	0.05	mg/L	EPA 300.0	28 days
Hardness, total (as CaCO ₃)	calculated	mg/L	APHA 2340B	N/A
Iron, total recoverable	0.01	mg/L	EPA 200.7	6 months
Kjeldahl nitrogen	0.1	mg/L	EPA 351.1	28 days
Lead, total recoverable	1	μg/L	EPA 200.9	6 months
Magnesium, total recoverable	0.05	mg/L	EPA 200.7	6 months
Manganese, total recoverable	0.005	mg/L	EPA 200.7	6 months
Mercury, total	0.0005	mg/L	EPA 245.2	13 days
Molybdenum, total recoverable	0.02	mg/L	EPA 200.7	6 months
Nickel, total recoverable	1	μg/L	EPA 200.9	6 months
Nitrate (as N)	0.01	mg/L	EPA 300.0	48 hours
Nitrite (as N)	0.05	mg/L	EPA 300.0	48 hours
pH (field)	0.1	pH unit	APHA 4500-H ⁺	Immediate
Phosphate, ortho- (as P)	0.01	mg/L	EPA 300.0	48 hours
Phosphorus, total (as P)	0.01	mg/L	EPA 365.1	28 days
Potassium, total recoverable	0.05	mg/L	EPA 200.7	6 months
Selenium, total recoverable	2	μg/L	EPA 200.9	6 months
Silica, total recov. (as SiO ₂)	0.1	mg/L	EPA 200.7	28 days
Silver, total recoverable	1	μg/L	EPA 200.9	6 months
Sodium, total recoverable	0.05	mg/L	EPA 200.7	6 months
Specific conductance	variable	umhos/cm	EPA 120.1	28 days
Sulfate	10	mg/L	EPA 300.0	28 days
Thallium, total recoverable	0.05	mg/L	EPA 200.7	6 months
Total organic carbon	0.5	mg/L	APHA 5310B	28 days

Total suspended solids	1	mg/L	EPA 160.2	7 days
Turbidity	0.5	NTU	EPA 180.1	48 hours
Vanadium, total recoverable	0.005	mg/L	EPA 200.7	6 months
Zinc, total recoverable	0.005	mg/L	EPA 200.7	6 months
Temperature (field)	1	degrees C.	APHA 2550 B	Immediate

TABLE 4.4-2

ROUTINE PESTICIDES AND RELATED COMPOUNDS

CONSTITUENT OR PHYSICAL PROPERTY	REPORTING LIMIT	REPORTING UNIT	ANALYTICAL METHOD	HOLDING ¹ TIME
Acetochlor	0.1	μg/L	EPA 608	7 days
Alachlor	0.1	μg/L	EPA 608	7 days
Aldrin	0.025	μg/L	EPA 608	7 days
Atrazine	0.3	μg/L	EPA 608	7 days
Butachlor	0.5	μg/L	EPA 608	7 days
Carbofuran	0.5	μg/L	EPA 608	7 days
Chlordane	0.2	μg/L	EPA 608	7 days
Cyanazine	0.5	μg/L	EPA 608	7 days
DCPA	0.05	μg/L	EPA 608	7 days
p,p'-DDD	0.04	μg/L	EPA 608	7 days
p,p'-DDE	0.02	μg/L	EPA 608	7 days
p,p'-DDT	0.1	μg/L	EPA 608	7 days
Dieldrin	0.05	μg/L	EPA 608	7 days
Endosulfan I	0.02	μg/L	EPA 608	7 days
Endosulfan II	0.02	μg/L	EPA 608	7 days
Endosulfan sulfate	0.1	μg/L	EPA 608	7 days
Endrin	0.1	μg/L	EPA 608	7 days
alpha-BHC	0.025	μg/L	EPA 608	7 days
beta-BHC	0.05	μg/L	EPA 608	7 days
delta-BHC	0.05	μg/L	EPA 608	7 days
gamma-BHC	0.025	μg/L	EPA 608	7 days

Heptachlor	0.02	μg/L	EPA 608	7 days
Heptachlor epoxide	0.02	μg/L	EPA 608	7 days
Hexachlorobenzene	0.1	μg/L	EPA 608	7 days
Methoxychlor	0.2	μg/L	EPA 608	7 days
Metolachlor	0.25	μg/L	EPA 608	7 days
Metribuzin	0.1	μg/L	EPA 608	7 days
PCB-1016	0.5	μg/L	EPA 608	7 days
PCB-1221	1	μg/L	EPA 608	7 days
PCB-1232	0.5	μg/L	EPA 608	7 days
PCB-1242	0.5	μg/L	EPA 608	7 days
PCB-1248	0.5	μg/L	EPA 608	7 days
PCB-1254	0.5	μg/L	EPA 608	7 days
PCB-1260	0.5	μg/L	EPA 608	7 days
Picloram	0.8	μg/L	EPA 615	7 days
Propachlor	0.25	μg/L	EPA 608	7 days
Propazine	0.3	μg/L	EPA 608	7 days
Silvex, as acid (2,4,5-TP)	0.4	μg/L	EPA 615	7 days
Simazine	0.3	μg/L	EPA 608	7 days
Toxaphene	2	μg/L	EPA 608	7 days
2,4-D as acid	0.8	μg/L	EPA 615	7 days
2,4,5-T as acid	0.4	μg/L	EPA 615	7 days

¹Pesticide samples must be extracted within 7 days of collection and analyzed within 40 days of extraction.

TABLE 4.4-3

ROUTINE RADIOLOGICAL PARAMETERS

CONSTITUENT OR PHYSICAL PROPERTY	REPORTING LIMIT	REPORTING UNIT	ANALYTICAL METHOD	HOLDING TIME
Antimony-125	35	pCi/L	GA-01	5 days
Barium-140	10	pCi/L	GA-01	5 days
Beryllium-7	64	pCi/L	GA-01	5 days

Cesium-134	5	pCi/L	GA-01	5 days
Cesium-137	7	pCi/L	GA-01	5 days
Cesium-141	8	pCi/L	GA-01	5 days
Cesium-144	35	pCi/L	GA-01	5 days
Chromium-51	52	pCi/L	GA-01	5 days
Cobalt-58	4	pCi/L	GA-01	5 days
Cobalt-60	11	pCi/L	GA-01	5 days
Gallium-67	30	pCi/L	GA-01	5 days
Gross Alpha	1	pCi/L	EPA 900.0	5 days
Gross Beta	4	pCi/L	EPA 900.0	5 days
Indium-111	11	pCi/L	GA-01	5 days
Iodine-123	10	pCi/L	GA-01	5 days
Iodine-131	5	pCi/L	GA-01	5 days
Iron-59	8	pCi/L	GA-01	5 days
Lanthanum-140	9	pCi/L	GA-01	5 days
Manganese-54	4	pCi/L	GA-01	5 days
Molybdenum-99	5	pCi/L	GA-01	5 days
Neptunium-239	41	pCi/L	GA-01	5 days
Niobium-95	7	pCi/L	GA-01	5 days
Potassium-40	88	pCi/L	GA-01	5 days
Radium-226	116	pCi/L	GA-01	5 days
Ruthenium-103	10	pCi/L	GA-01	5 days
Ruthenium-106	55	pCi/L	GA-01	5 days
Silver-110m	4	pCi/L	GA-01	5 days
Technetium-99m	10	pCi/L	GA-01	5 days
Thorium-228	387	pCi/L	GA-01	5 days
Tritium	350	pCi/L	EPA 906.0	5 days
Ytterbium-169	28	pCi/L	GA-01	5 days
Zinc-65	8	pCi/L	GA-01	5 days
Zirconium-95	6	pCi/L	GA-01	5 days

TABLE 4.4-4

ROUTINE BACTERIOLOGICAL PARAMETERS

CONSTITUENT OR PHYSICAL PROPERTY	REPORTING LIMIT	REPORTING UNIT	ANALYTICAL METHOD	HOLDING TIME
Fecal coliform bacteria	variable	colonies/100 ml	APHA 9222D	24 hours

4.5 Internal Procedures for Assessing Data Precision, Accuracy, Representativeness and Comparability

4.5.1 In-house Audits

The section chief conducts annual audits of field and laboratory equipment and procedures. Each audit is comprised of (1) a system audit, consisting of a qualitative, onsite review of QA systems and physical facilities for monitoring, measurement and calibration and (2) a performance audit, in which a quantitative assessment is made of the bias (accuracy) and variability (precision) of analytical measurements. During system audits, staff responsible for sample collection and field operations are required to demonstrate a proper understanding of the requirements imposed by the QA management plan and accompanying SOPs. During performance audits, staff are required to conduct field measurements in the presence of the section chief and to report measured values for temperature and pH that fall within five percent of the values established by the section chief. Should these values fall outside control limits, the section chief and field worker initiate corrective actions as described in section 4.7.

4.5.2 Instrument Calibration and Standardization

At monthly intervals, the performance of thermometers used in the field is checked against a reference thermometer traceable to the National Institute of Standards and Technology (NIST). Before leaving for the field, monitoring staff are expected to calibrate the pH meter and test the instrument for normal operation. The pH meter is standardized in the field, immediately prior to use, using NIST-traceable pH buffer solutions (Appendix B). This instrument must meet all manufacturer performance specifications. Should the meter be found to drift significantly, more frequent calibrations are performed or corrective action procedures are invoked (section 4.7.1).

4.5.3 Field Blanks

The possibility of sample contamination during sample preparation, handling, storage and analysis is assessed through the use of field blanks prepared with demineralized water and subjected to the same treatment as surface water samples. (Contamination is an especially important consideration when sampling for trace metals and metalloids, as ambient concentrations of these parameters are often less than 1.0 $\mu\text{g/L}$, and sample concentrations may be greatly augmented through exposure to airborne particulate matter, etc.). On each sampling run, or on at least one run during any week of

sampling, the weighted stainless-steel bucket and stainless-steel pail are filled under field conditions with demineralized water initially meeting ASTM Type-I specifications. This water (blank sample) is transferred to a complete set of randomly selected sample containers and subjected to the same preservation, handling, storage and analysis procedures as the actual field samples (Appendix B). If the limits for sample contamination presented in section 2, paragraph (1) are exceeded, corrective actions are implemented in accordance with section 4.7.2, below.

4.5.4 Field Duplicate Samples and Spiked Samples

Quality control measures implemented in the field also include the collection of duplicate samples and preparation of spiked samples. Duplicate samples are obtained from a minimum of one station on each sampling run (Appendix B). At least six times each year, a set of spiked samples is prepared in the field under the direct supervision of the program manager through the addition of known concentrations of selected parameters to one of the sets of duplicate samples. Later, following laboratory analysis, measured levels of the selected parameters in spiked samples are compared to those in the unamended duplicates to provide an overall indication of sample degradation and analytical recovery. Field spikes are prepared using high accuracy and high precision fixed- and adjustable-volume pipette, volumetric glassware, and certified reference standards obtained from EPA, USGS or appropriate commercial vendors (Appendix B). Should the precision and/or accuracy of the data fall outside the control limits established in section 2, paragraph (1), corrective action procedures are invoked in accordance with section 4.7.3, below.

4.5.5 Preventative Maintenance

Periodic inspection of sampling and analytical equipment and routine maintenance of this equipment is necessary to minimize malfunctions which could result in the loss of data or disrupt program activities. Field instrumentation must routinely be inspected prior to use and calibrated at intervals recommended by the manufacturer. Equipment maintenance logs must be maintained for all field thermometers and pH meters. Vehicles used for field activities must be maintained in a reliable condition and kept free of trash, debris, tobacco products, or other materials that could significantly increase the risk of sample contamination. Entries must be made in the vehicle log upon completion of each field trip. Instrument and vehicle malfunctions shall be reported to the program manager as soon as possible to expedite necessary repairs or the acquisition of new equipment (section 4.7).

4.5.6 Safety Considerations

Attention to job safety protects the health and well-being of program staff and helps maintain a work atmosphere which ultimately enhances data quality and consistency. Program staff must be familiar with proper precautionary measures and the use of available safety equipment prior to assuming field duties. Each vehicle used in the stream chemistry monitoring program must be maintained in proper operating condition and equipped with a first aid kit, safety goggles, portable eye wash station, fire extinguisher, spare tire and tire changing equipment, rain gear, emergency road reflectors and/or flares, and at least one operable flashlight. Monitoring staff are expected to check out cellular phones from BEFS clerical staff on a routine basis, in the event of vehicle mishaps, medical problems, or other emergencies in the field. The use of a cellular phone is especially important when

conducting overnight sampling runs or when traveling alone or during periods of potentially severe weather.

Care must be taken when handling glassware and chemical reagents in the field. Chemicals reagents used in the field include manganous sulfate (eye and mucous membrane irritant), alkaline potassium azide iodide (oral toxin), concentrated sulfuric acid (strong acid and oxidizer), dilute sulfuric acid (skin, mucous membrane and eye irritant), nitric acid (strong acid and oxidizer), and pH buffer solutions (eye and mucous membrane irritants). Staff should not engage in the use of these reagents or breakable glassware if the weather, terrain, traffic or any other concern impedes concentration, reduces visibility, jeopardizes footing, or otherwise precludes the safe handling of these materials. Rather, staff should move to a level, dry, protected, and well lighted area before preserving or analyzing samples. If the wind is blowing strongly, staff should avoid handling samples and reagents immediately upwind of their face and eyes. Additional safety considerations are presented in the SOPs accompanying this QA management plan.

4.6 External Procedures for Assessing Data Precision, Accuracy, Representativeness and Comparability

At the discretion of the section chief, bureau QA representative or other administrative staff, the stream chemistry monitoring program may, from time to time, participate in independent audits or in cooperative, interlaboratory sample comparison programs or reference sample programs. Participation in such activities promotes scientific peer review and enhances the technical integrity and overall credibility of the program.

4.7 Corrective Action Procedures for Out-of-Control Situations

4.7.1 Equipment Malfunction

Any equipment malfunction discovered by staff during routine calibration activities or during an internal or external performance audit shall be recorded in the appropriate logbook and immediately reported to the program manager. The program manager is responsible for appraising the scope and seriousness of the problem and, if necessary, for determining whether the instrument should be repaired or replaced. The program manager also is responsible for ensuring that backup instrumentation is available for all critical field activities. Similarly, arrangements for a backup vehicle must be made in advance of any mechanical problems or mishaps that might render the vehicle inoperable for an extended period.

4.7.2 Sample Contamination

Blank concentrations outside the control limits established in section 2, paragraph (1), detract from the quality and credibility of the stream chemistry data and must be resolved in a timely manner. In instances where the source of the contamination is unknown, the program manager shall conduct an investigation to determine whether the problem is of likely field or laboratory origin. Field contamination problems may result, for example, from improper sample collection technique or exposure to contamination sources at the sampling site or within the vehicle used to transport the

samples. Laboratory problems may include contaminated water supply or reagents, contaminated glassware, or some less conspicuous problem. Program staff shall work closely with KHEL personnel to identify and eliminate contamination sources. Persistent problems shall trigger a program audit by the section chief and/or bureau QA representative and ultimately may result in the removal of questionable data from the stream chemistry database.

4.7.3 Data Precision/Accuracy Problems

Should stream chemistry data fail to meet the precision and accuracy requirements of section 2, paragraph (1), the program manager shall initiate an investigation to determine the cause of the problem. The program manager shall work closely with KHEL to identify the cause and implement appropriate corrective measures. Persistent problems may trigger a program audit by the section chief or bureau QA representative, result in the disqualification of a substantial amount of stream water quality data, or invoke other remedial measures (e.g., independent audit).

4.7.4 Staff Performance Problems

Should a member of the program staff have difficulty with a given work procedure (e.g., as determined by an internal performance audit), an effort shall be made by the program manager to identify the scope and seriousness of the problem, to identify any data affected by the problem, and to recommend to the section chief an appropriate course of corrective action. All questionable data are either flagged within the computer database or, at the discretion of the section chief, deleted from the database. Possible corrective actions include, but are not necessarily limited to, further in-house or external training for the employee, a reassignment of work duties, or modification of the work procedure.

4.8 Data Management

4.8.1 General Data Management

All field- and laboratory-generated data on surface water quality are handled in an orderly and consistent manner. Time and date of sample collection, monitoring station identification number, sample chain-of-custody, and other basic information is recorded on standardized sample submission forms (Appendix C). Original forms are retained by sampling staff and routed to the program manager or his/her designee for filing. Photocopies are retained by KHEL along with the samples (Appendix B). Upon completion of the laboratory analyses, the KHEL Data General "Avionics" computer automatically downloads data to the Kansas Water Database, which is accessed through the KDHE IBM AS-400 computer system. Data files are processed using in-house conversion programs to convert data from ASCII flat files to the Kansas Water Database storage format. The Kansas Water Database is supported and backed-up daily by the KDHE Office of Information Systems (OIS).

Hardcopies of all water chemistry and bacteriological data generated by KHEL are stored in the BEFS files. These data are reviewed by the program manager and/or environmental technician III for any obvious errors or omissions. Information derived from field QC samples (duplicates, spikes,

blanks, etc.) are subjected to particularly thorough review. With the approval of the program manager, data that are deemed inaccurate, or grossly unrepresentative, are purged from the electronic database (section 4.8.4, below). Redundant forms of data storage and backup (e.g., EPA STORET system, Kansas Water Database, KHEL tape files, BEFS hardcopy files) help to ensure the long-term integrity and availability of the program data.

Newly acquired data are transferred electronically from the Kansas Water Database to the EPA STORET database at least once each year. Prior to this transfer, an EPA computer program called “Rum-dum” scans the data and identifies any value that is outside the historical range for a given parameter and monitoring site. This value is not entered into the EPA STORET database but is reported to BEFS for further investigation and validation. The manager of the stream chemistry monitoring program compares this value to that recorded on the original field sheet and/or laboratory reporting form. He/she also may consult with other program personnel and/or KHEL analytical staff and consider any relevant (field or laboratory) QC documentation. If the value is ultimately deemed erroneous or suspect, it is removed from the Kansas Water Database and not entered into the EPA STORET database. If it is deemed valid, the Rum-dum program is modified to accept the value and accommodate the new range of historical values for the parameter and monitoring site in question.

4.8.2 Data Entry Requirements

Data for field pH and temperature recorded on laboratory sample submission forms are entered manually by KHEL staff into the laboratory database. These values are examined and verified at least monthly by staff of the stream chemistry monitoring program via comparison to the original field sheets. Staff transferring or receiving data electronically perform random spot checks of the data and report any problems to KHEL, OIS and/or EPA for further investigation and resolution. Persistent problems are reported to the section chief and bureau QA representative for consideration of necessary corrective actions.

4.8.3 Verification of Calculations

Computer-based mathematical, statistical, graphical and geographical programs and models involving environmental data are tested before application by comparison to other computer programs, through hand calculations involving randomly selected data, or through other appropriate means. The reliability of these models and programs is reexamined on at least an annual basis or whenever a problem is reported within a computational system. Quattro Pro, Excel, ArcView and PC SAS are among the forms of software used for generating spreadsheets, graphs and maps and for performing statistical characterizations, comparisons and trend analyses.

4.8.4 Data Transformation, Outliers and Reporting Limits

Many forms of environmental data do not conform to a normal distribution and may necessitate the use of nonparametric statistical methods. Alternatively, the data may be transformed statistically to induce a normal or log normal distribution or some other preferred data distribution. In general, data are first graphed to reveal the general shape of the distribution and to help identify the most appropriate transformation procedure. Commercially available computer programs may be applied

in more detailed assessments of data distribution. PC SAS software maintained on one of the BEFS desk top computers offers several algorithms for characterizing departure from normality (e.g., Shapiro-Wilk and Kolomogorov tests available through the UNIVARIATE procedure).

Water quality data occasionally may include anomalous values or statistical outliers. Obvious outliers (those that are orders of magnitude beyond any reasonable value) often constitute data transcription errors or measurement unit conversion errors. In other instances, outliers may reflect the gross contamination of samples, analytical errors, or an actual (though rarely occurring) fluctuation in water quality. In the stream chemistry monitoring program, data are automatically questioned by staff if reported duplicate concentrations vary by more than 30 percent or if a value is outside the historical range for the parameter and monitoring site in question. If follow-up consultations with field, laboratory, and data management personnel provide no reasonable explanation for a questionable value, the program manager may flag the value or delete the value from the database.

Parameter concentrations that are less than the applicable minimum reporting limit (MRL) established by KHEL tend to complicate data analysis. Although a hypothetical value of one-half the MRL may be assigned to facilitate statistical examination, the MRL itself, or a value of zero, may be more appropriate in some applications. Concentrations of fecal coliform bacteria are occasionally reported as greater than the applicable upper reporting limit. In such instances the upper reporting limit may be assigned in place of a known concentration, and any computed average or related statistic given a “greater than” designation. Nonparametric procedures based on rank-order or percentiles tend to be less influenced by these kinds of data and are often favored by staff performing statistical characterizations, comparisons and trend analyses.

4.8.5 Ancillary Data

Ancillary data used in this program may include hydrological, meteorological, or biological data derived from other state or federal agencies. An effort is made to ensure that these agencies have appropriate QA plans in place. In some instances, these agencies collect data under contract to KDHE, or under the auspices of an EPA grant, both of which require development and approval of a QAPP prior to data collection (see QMP, Part I, section 2.3). Pollutant loading coefficients and some other values applied in modeling calculations are taken from documents produced by governmental agencies or from literature sources incorporating peer review of articles before publication. Program staff carefully examine the underlying technical assumptions before applying these coefficients and values.

4.9 Quality Assurance Reporting Procedures

End-of-year program evaluations are conducted by the section chief, and a written report is submitted to the bureau QA representative, bureau director and divisional QA officer by February 15 of the following year. The program manager cooperates in this evaluation and makes available all records gathered during the evaluation period on the precision, accuracy, representativeness and comparability of the monitoring data. Program evaluations submitted by the section chief indicate when, how, and by whom the evaluation was conducted, the specific aspects of the program

subjected to review, a summary of significant findings, and technical recommendations for necessary corrective actions. The section chief discusses the reported findings with the program manager and other program staff.

4.10 Purchased Equipment and Supplies

When newly ordered or repaired sampling, analytical or computational equipment is delivered to the program office, the program manager (or designee) compares the item to that requested on the original order, then inspects the equipment to ensure no breakage has occurred in transit and all components function properly. Once this inspection is completed, the manager (or designee) either accepts or rejects the shipment. Office and laboratory supplies receive a comparable level of scrutiny. Reference standards and equipment must be accompanied by a certificate from the vendor or manufacturer verifying the quality of these products.

4.11 Program Deliverables

Program deliverables include electronic databases, illustrative materials, statistical water quality summaries, and detailed written reports used in a variety of agency applications. Staff of the stream chemistry monitoring program play a major role in the development of the Kansas biennial water quality assessment (305(b) report) and the Kansas list of water quality limited surface waters (303(d) list). As resources and circumstances allow, customized data retrievals are prepared by the program manager on behalf of administrative staff, legislative officials, other state and federal agencies, regulated entities, special interest groups, consultants, academicians, students, and members of the general public.

Section 5

REVIEW AND REVISION OF PLAN

To ensure that the stream chemistry monitoring program continues to meet the evolving informational needs of the bureau and the agency, all portions of this QA management plan and its appended SOPs must be comprehensively reviewed by participating staff on at least an annual basis. Revisions to the plan and SOPs require the approval of the program manager, section chief and bureau QA representative prior to implementation. Although review and revision activities normally follow the annual program evaluation in February, these activities may be implemented at any time based on urgency of need or staff workload considerations.

Original approved versions of the QA management plan and SOPs, and all historical versions of these documents, are maintained by the bureau QA representative or his/her designee. The bureau QA representative also maintains an updated electronic version of the plan and SOPs on the KDHE internet server in a "read only" .pdf format.

APPENDIX A

FIELD EQUIPMENT AND SUPPLY CHECKLIST

FIELD EQUIPMENT AND SUPPLY CHECKLIST

I. VEHICLES

- A. Primary sampling vehicle (three-quarter ton van with 17-foot wheel base, load range D tires, sliding/latching side door, double back door, cargo safety screen, roof-mounted hazard lights)

Alternate vehicles and district vehicles (various models, attributes and accessories, depending on available vehicles)
- B. Vehicle registration and proof of insurance
- C. Vehicle log book (credit card, Fuelman card, list of Fuelman service stations, copy of tire and battery service contracts)
- D. Vehicle key and spare key(s)
- E. Mobile cellular telephone with magnetic mountable antenna, carrying case, instructions
- F. Fluorescent orange safety vests with reflective strips, orange or yellow rain coats or ponchos with reflective strips
- G. Fire extinguisher, first aid kit, CPR mouthpieces, latex rubber gloves, paper and cloth towels, hand sanitizing solution in plastic squeeze bottle, safety goggles, portable eyewash station
- H. Spare tire (fully inflated), tire changing equipment, road reflectors and/or flares
- I. Tool kit, jumper cables, tow rope, windshield ice scrapers, flashlights (fully operable)

II. OTHER FIELD EQUIPMENT AND SUPPLIES

- A. Weighted stainless-steel sampling bucket (1 gal)
- B. Stainless-steel pail (1 gal)
- C. Stainless-steel funnel
- D. Stainless-steel crucible tongs
- E. Rope, cotton fiber, 75-ft length with snap swivel

- F. Coleman ice chests (100-qt capacity) containing bags of crushed ice
- G. Wooden flats for sample container storage
- H. Plastic tubs for sample handling and transport
- I. Sample containers (including two or more sets of spare containers)
- J. Glass beakers (100 ml)
- K. Polyethylene disposable gloves
- L. Demineralized water (in squeeze bottles and cubitainers)
- M. Clipboard (with maps, field sheets, etc.), pencils, pens, markers and labeling tape
- N. Camera, 35-mm, with film (or digital diskette), carrying case, instructions

III. FIELD MEASUREMENT APPARATUS

- A. Ashtech "Reliance" global positioning system (GPS) backpack receiver (with Psion data logger, antenna and carrying case)
- B. Fisher model #15-0778 stainless-steel dial scale thermometer (-10 to +110 °C)
- C. Cole-Parmer model #5996-70 field pH meter (analog readout with instruction manual, carrying case, combination pH probe, and pH 4, 7 and 10 buffer solutions)
- D. Winkler dissolved oxygen kit (with reagents "1, 2, 3" in 250-ml Nalgene safety squeeze bottles, transported in sealed plastic container with removable lid; another reagent, used for nutrient sample preservation, is included in this kit in a separate safety squeeze bottle labeled "4"; see Appendix B)

APPENDIX B

STANDARD OPERATING PROCEDURES

TABLE OF CONTENTS

<u>Procedure</u>	<u>Revision No.¹</u>	<u>Date</u>
Global Positioning System (GPS) Procedures for Determination of Geographical Location of Stream Monitoring Stations (SCMP-001)	0	12/01/00
Vehicle Safety and Maintenance Procedures (SCMP-002)	0	12/01/00
Operational and Maintenance Procedures for Field Analytical Equipment (SCMP-003)	0	12/01/00
Procedures for Field Analytical Measurements (SCMP-004)	(R)	12/01/00
Procedures for Collecting, Preserving and Transporting Stream Water Samples (SCMP-005)	0	12/01/00
Chain-of-Custody Procedures for Stream Water Samples and Field- Prepared Quality Control Samples (SCMP-006)	0	12/01/00
Procedures for Field Blank Samples (SCMP-007)	0	12/01/00
Procedures for Field Duplicate and Replicate Samples (SCMP-008)	0	12/01/00
Procedures for Field Spiked Samples (SCMP-009)	0	12/01/00

¹The designation “(R)” indicates a procedure or set of procedures has been rescinded or incorporated into another SOP.

**GLOBAL POSITIONING SYSTEM (GPS) PROCEDURES FOR
DETERMINATION OF GEOGRAPHICAL LOCATION OF STREAM
CHEMISTRY MONITORING STATIONS (SCMP-001)**

I. INTRODUCTION

A. Purpose

Accurate documentation of geographical position (longitude and latitude) reduces the risk of obtaining samples from the wrong monitoring site and facilitates the analysis of monitoring data through geographical information system (GIS) techniques. The location of all monitoring sites included in the KDHE stream chemistry monitoring network must be precisely documented using GPS procedures.

B. Minimum Staff Qualifications

Personnel implementing this SOP should meet the minimum classification requirements for environmental technician II published by the Kansas Department of Administration. They also should be experienced in the use of GPS equipment and possess a basic understanding of the underlying technology.

C. Equipment/Accessories

1. Carry bag or case
2. Receiver back pack
3. Ashtech "Reliance" GPS receiver
4. Psion data logger
5. Psion coiled cable, 1.3 m
6. Protective cover for data logger
7. Receiver batteries, 12 v (2)
8. Receiver battery connector
9. Auxiliary battery connector (vehicle)
10. Remote battery chargers (2)
11. Antenna, adapter, and magnetic base
12. Antenna poles, 11 cm and 47 cm
13. Antenna cable, 2.5 m
14. Receiver download cable

II. PROCEDURES

A. Equipment Set-Up and Operation

Procedures described in the Ashtech Reliance (Submeter) GPS System Guide, which may be viewed on the KDHE intranet server (GIS section), are adopted by reference.

B. Equipment Take-Down and Data Processing

Procedures described in the Ashtech Reliance (Submeter) GPS System Guide, which may be viewed on the KDHE intranet server (GIS section), are adopted by reference.

VEHICLE SAFETY AND MAINTENANCE PROCEDURES (SCMP-002)

I. INTRODUCTION

A. Purpose

The following text outlines vehicle safety and maintenance procedures used during the collection and transport of stream chemistry samples. Safety procedures are established to prevent or minimize property damage, personal injuries, and/or loss of life. Maintenance procedures are established to prevent or minimize vehicle breakdowns and to extend the usable life of the vehicle. Accidents and mechanical failures are costly and result in loss of productivity.

B. Minimum Staff Qualifications

Personnel implementing this SOP should meet the minimum classification requirements for environmental technician II published by the Kansas Department of Administration. They also should possess a valid Kansas driver's license and current certifications in both standard first aid and cardiopulmonary resuscitation (CPR). Although not required, these employees are strongly encouraged to participate in defensive driving courses offered by some law enforcement agencies and other qualified organizations.

C. Equipment/Accessories

Van, three-quarter ton, with 17-foot wheel base, load range D tires, sliding/latching side door, double back door, cargo safety screen, mounted emergency flashing lights, portable emergency road reflectors or road flares, fire extinguisher, spare tire, tire changing equipment, jumper cables, tow rope, tool kit, first aid kit, disposable latex gloves, disposable CPR mouthpiece, safety goggles, emergency eye wash station, flashlight, windshield ice scraper, cellular phone with magnetic mountable antenna, AM/FM radio, and all other equipment indicated in Appendix A. (Note: any other vehicle driven by program staff or district office staff while engaged in stream monitoring operations should include comparable safety equipment and accessories, with the exception of the cargo screen, sliding and double doors, and roof-mounted hazard lights which are installed only on the primary sampling van.)

II. PROCEDURES

A. Vehicle Safety Procedures

1. The following conditions and safety precautions must be met and observed while operating motor vehicles in association with stream monitoring operations:

- a. Vehicle operators must possess a valid Kansas driver's license.
 - b. Drivers shall abide by all applicable regulations for operation of motor vehicles.
 - c. SEAT BELTS MUST BE WORN AT ALL TIMES WHILE OPERATING OR RIDING IN MOTOR VEHICLES.
 - d. Drivers shall observe posted speed limits. Upon encountering slippery road conditions, high winds, reduced visibility, road construction, heavy traffic, slower traffic (e.g., farm or construction vehicles, bicycles, pedestrians, saddle horses, horse drawn carriages, trucks with oversized loads, military convoys, etc.) or other conditions warranting greater caution, drivers shall slow to a reasonable and prudent speed.
 - e. Driver's shall avoid tailgating or "drafting" and observe proper driving intervals behind the vehicle ahead.
 - f. Drivers shall pass other vehicles only where the safety and legality of passing is not in doubt.
 - g. Electrical turn signals or, in emergencies, proper hand signals shall be used when operating vehicles.
 - h. Drivers shall become familiar with vehicle manufacturer's operating instructions and drive vehicle accordingly.
2. Vehicles shall be checked for any apparent safety problems before and after each sampling trip. Vehicles with potentially serious operational defects shall not be used for sampling events. Concerns about vehicle safety shall be directed immediately to the program manager or higher level supervisor.
 3. Vehicles shall not be operated when the driver has been on the job for more than ten hours or when the driver is exhausted, ill, or taking medications or drugs that may cause drowsiness or impair sensory functions, reflexes or reasoning.
 4. Cargo transported in sampling vehicles shall not be stacked higher than the driver and passenger seat backs, even in vehicles equipped with cargo safety screens.

5. Except for the cargo safety screen and roof-mounted hazard lights, which are installed only on the primary sampling van, safety equipment indicated in paragraph I.C, above, shall be maintained in all agency vehicles used for stream chemistry monitoring operations.
6. Sampling vehicles shall not be parked in any location or in any manner that may create a traffic hazard or impede the flow of traffic. Parking or stopping of sampling vehicles on bridges is strictly prohibited.
7. When obtaining samples or performing related reconnaissance activities, park on the shoulder of the road within walking distance of the bridge (or as far to the side of the road as practicable if no shoulder exists). In urban and other heavily congested areas, a nearby parking lot generally offers the safest parking alternative.
8. Upon approaching a stream that is scheduled for sampling or reconnaissance activities, engage the roof-mounted hazard lights on the sampling van (or the emergency flashers on alternate vehicles and district vehicles). After parking near the bridge, check to make sure the hazard lights (or flashers) are engaged prior to leaving the parked vehicle. Look for traffic in the side-view mirror, then look for traffic over the shoulder, before opening the door.

B. Vehicle Maintenance Procedures

1. The sampling vehicle shall be scheduled for normal service maintenance every 5,000 miles. Routine maintenance is performed by the Central Motor Pool and typically includes changing of oil and oil filter, lubrication of chassis and suspension, checking of fluid levels/antifreeze strength, rotation of tires, and inspection of belts, hoses, tires, shocks and/or struts, brakes, air conditioner, heater, exterior lights, windshield wipers, and exhaust system. Other repairs are performed as needed.
2. Other routine maintenance, such as tune-ups, air and fuel filter replacement, wheel bearing inspection and grease repacking, "wheels off" brakes inspection, etc. shall be performed according to the vehicle manufacturer's recommendations. This information may be obtained either in the vehicle owner's manual or by contacting the Central Motor Pool.
3. All emergency repairs, unscheduled maintenance, or towing shall be performed by the Central Motor Pool, unless the vehicle is being utilized outside the Topeka vicinity. Minor "on the road" repairs costing less than \$200.00 (parts and labor) may be done by any qualified and authorized facility. If the repair estimates are greater than \$200.00, the Central Motor Pool must be contacted for approval prior to having any work done.

4. The purchase of tires and batteries is covered under State contract. A list of authorized vendors and acceptable types of tires or batteries may be found within the Central Motor Pool Automotive Battery Contract and Tire Contract. Copies of the current contracts shall be attached to the vehicle log clipboard.
5. An adequate supply of fuel shall be maintained in the gas tank at all times. Fuel can only be purchased with the FUELMAN card at FUELMAN locations. A current FUELMAN directory shall be attached to the vehicle clipboard. The Central Motor Pool is an official FUELMAN location that provides fuel at a price lower than other FUELMAN locations in Topeka. When purchasing gasoline away from Topeka, confirm that the vendor is an approved FUELMAN vendor prior to pumping fuel. During the refueling process, clean the windshield if necessary. If time permits, it is a good idea to check the engine oil level and visually inspect the tires.

Exceptions to the FUELMAN rule for monitoring program staff are as follows:

- (a) Each vehicle has a white state credit card that is a “backup” card to be used **only** in those circumstances when a FUELMAN location is not within a feasible driving distance. Again, it is best to verify that the facility will accept the card prior to pumping fuel into a vehicle. If using the white state credit card, only purchase fuel from self-service gasoline pumps.
 - (b) Fuel may be purchased with the white state credit card from state operated refueling stations at the University of Kansas in Lawrence, Kansas State University in Manhattan, or the State Correctional Facility in Lansing.
6. The vehicle log shall be updated each time the vehicle is utilized by entering the appropriate date, operator's name, mileage, and destination. All vehicle purchases and/or repair costs shall also be reported in the vehicle log. The vehicle logs and accompanying receipts shall be turned over to the KDHE Business Office on a monthly basis.

OPERATIONAL AND MAINTENANCE PROCEDURES FOR FIELD ANALYTICAL EQUIPMENT (SCMP-003)

I. INTRODUCTION

A. Purpose

The following text establishes standard procedures for the proper care, calibration, and maintenance of pH meters and thermometers.

B. Minimum Staff Qualifications

Personnel implementing this SOP should meet the minimum classification requirements for environmental technician II published by the Kansas Department of Administration. They also should be experienced in the measurement of the chemical and physical properties of surface water and have a basic technical understanding of the associated measurement apparatus.

C. pH Meter Specifications

Manufacturer:	Cole-Parmer
Instrument type:	Field Analog pH Meter
Model number:	5996-70
Range:	0 to 14 pH Units
Resolution:	0.01 pH Units

D. Thermometer Specifications

Manufacturer:	Fisher
Instrument type:	Dial scale thermometer
Model number:	15-0778
Range:	-10 to 110 degrees Celsius (°C)
Resolution:	1°C

II. PROCEDURES

A. pH Meter

The field pH instrument features battery operation, two point standardization, and manual temperature compensation. It is used in conjunction with a combination glass/calomel reference pH electrode. When properly calibrated, standardized, and compensated with respect to temperature, it provides an accurate analog readout of sample pH, defined as the negative logarithm of the hydrogen ion activity in moles

per liter. In most surface water samples and other dilute solutions, hydrogen ion activity is essentially identical to hydrogen ion concentration.

1. pH Meter Calibration and Standardization

- a. Meter is factory calibrated but may require zeroing of readout needle. Check needle position with meter turned off. If needle does not read zero, then use mechanical zero screw to adjust needle to zero.
- b. Connect pH electrode to instrument and remove electrode cap.
- c. Immerse electrode in pH 7 buffer solution and turn meter on. Stir electrode gently while adjusting **SET** control for a reading of 7.00. Allow reading to stabilize before proceeding to next step.
- d. Rinse the electrode thoroughly in de-ionized water, and gently shake off excess water.
- e. Immerse electrode in either pH 4 or pH 10 buffer solution.
- f. Allow a few seconds for the reading to stabilize, then adjust **SLOPE** control for a pH reading of 4.00 or 10.00 (depending on buffer used).
- g. Rinse the electrode in de-ionized water, and shake off excess water.
- h. Meter is now calibrated, standardized, and ready to use.

NOTE: Above steps should be repeated at beginning of each day of sampling run. Measure pH 7.00 buffer at intervals during day as additional safeguard. If zeroing and standardization are necessary, also repeat steps d-h, above.

2. pH Meter Operation

- a. After above procedures are completed, immerse electrode in sample. Set temperature knob to sample temperature (measured with Fisher model #15-0778 stainless-steel dial scale thermometer; see below). Gently stir electrode, and allow time for pH reading to stabilize.
- b. After stabilization, read the analog display for sample pH. Record indicated pH value on field data sheet.
- c. Using plastic squeeze bottle filled with de-ionized water, rinse electrode tip and barrel thoroughly. Immerse electrode bulb and lower barrel in 100-ml beaker of demineralized water between sample measurements.

3. pH Meter Inspection and Maintenance

- a. Proper calibration of instrument must be confirmed prior to each field trip. If meter is malfunctioning, a backup meter must be used pending repair or replacement of original meter.
- b. Routine maintenance includes periodic electrode and battery replacement. At a minimum, batteries and electrodes must be replaced annually. All maintenance checks and electrode/battery replacements must be recorded in instrument log book.
- c. If electrode becomes dirty or if a crust develops, rinse thoroughly with de-ionized water or stir electrode in water and detergent solution. **DO NOT** abrade electrode by wiping or cleaning with cloths or paper towels. For protein layers, wash electrode tip with pepsin or 0.1N HCL; for inorganic deposits, wash with EDTA or acids; and for grease or similar films, wash with acetone, methanol or diethyl ether in an appropriately ventilated area well removed from any open flame.
- d. Record all operational problems, routine maintenance actions, and instrument repairs in instrument log book.

B. Thermometer

The Fisher model #15-0778 stainless-steel dial scale thermometer is an easy to use, portable, manual, direct read instrument. It measures temperature in Celsius ranging from -10 to 110 degrees.

1. Thermometer calibration is accomplished by comparing instrument to an NIST-traceable reference thermometer. If adjustment is required, carefully turn adjusting nut located on back of dial until correction is completed.
2. When measuring temperature of sample, immerse at least a couple of inches of slender probe into sample. Avoid touching probe just prior to and during measurement. Read temperature to nearest one degree by observing indicator on dial. Do not use thermometer to measure substances colder than -10°C or hotter than 110°C.
3. Procedures for thermometer maintenance include a thorough inspection prior to every field season to ensure instrument is properly calibrated and operating within manufacturer's specifications. If instrument is malfunctioning and/or cannot be calibrated, it must be replaced. If probe becomes dirty or if a crust develops, rinse it thoroughly with de-ionized water or a mild detergent solution.

PROCEDURES FOR FIELD ANALYTICAL MEASUREMENTS (SCMP-004)

(NOTE: This procedure, first adopted in 1995, has since been incorporated into SCMP-003. The designation "SCMP-004" has been reserved to avoid the need for renumbering other original SOPs).

PROCEDURES FOR COLLECTING, PRESERVING AND TRANSPORTING STREAM WATER SAMPLES (SCMP-005)

I. INTRODUCTION

A. Purpose

The following text outlines the proper procedures for the collection, preservation and transport of stream water samples.

B. Minimum Staff Qualifications

Personnel implementing this SOP should meet the minimum classification requirements for environmental technician II published by the Kansas Department of Administration. They also should be experienced in the measurement of the physicochemical and microbiological properties of surface water and in the performance of environmental field investigations.

C. Field Equipment and Supply Checklist

See Appendix A.

II. PROCEDURES

A. Safety Requirements and Protocols

- 1. All program personnel must read SCMP-002, Vehicle Safety and Maintenance Procedures, before engaging in stream sampling or reconnaissance operations. Procedures and requirements indicated in SCMP-002 must be strictly observed by program personnel.**
- 2. Personnel collecting a sample or performing reconnaissance shall be alert to traffic conditions and exercise caution when walking between sampling vehicle and bridge and when working from bridge. Fluorescent orange safety vests (or jackets) with reflective strips, or orange or yellow rain coats (or ponchos), shall be worn by all sampling personnel upon exiting sampling vehicle.**
- 3. Sample collectors must apply caution when leaning over bridge railings to lower or retrieve sampling buckets/pails or other equipment. Added caution must be applied when sampling from slippery or icy bridge surfaces.**

4. **Sampling and reconnaissance operations shall not be attempted if rising water, flooding, inclement weather, bridge or road damage or repairs, or other conditions preclude performance of duties in a safe manner.**
5. **If ice formation, shallow water or other conditions preclude collection of samples from bridge, sampling personnel may attempt to access stream from shore, within road public right-of-way, provided this can be done without undue risk of personal injury or harm. Staff shall not walk or drive on frozen streams during stream sampling or reconnaissance operations.**
6. **Staff shall wear safety goggles and disposable polyethylene gloves (or other suitable hand and eye protection) when preserving samples with acids or other chemical reagents or when handling samples that are obviously contaminated with sewage effluent, livestock waste, or other potentially hazardous or infective materials. Staff shall avoid handling containers with acids or other reagents when sampling vehicle is in motion.**
7. **Field equipment and supplies, including ice chests, sample containers and containers bearing acids or other chemical reagents, shall be safely stored and secured during transport. Plastic bottles containing acids or other chemical reagents shall be capped and placed in covered plastic storage container when not in use.**

B. Collection and Preservation of Stream Water Samples

1. At each monitoring site, stream water samples are obtained from bridge using a rope and weighted stainless-steel bucket or stainless-steel pail. Each sample is collected from downstream side of bridge and from apparent thalweg (deepest appearing point in stream channel cross section; see glossary), unless woody debris or other obstructions or conditions dictate otherwise. The thalweg generally is associated with main flow or main braid of stream.
2. The weighted stainless-steel bucket normally is used to obtain the following sample fractions: dissolved oxygen, minerals (total suspended solids, major cations and anions, specific conductance, total dissolved solids, biochemical oxygen demand, total organic carbon), nutrients (Kjeldahl nitrogen, total ammonia, total phosphorus), trace elements (various metals and metalloids), fecal coliform bacteria, and pH and temperature. The stainless-steel pail is used for pesticide samples (selected pesticides, pesticide degradation products, PCBs), radionuclide samples and, if necessary, volatile organic compound (VOC) samples.

3. If stream is too shallow for using weighted stainless-steel bucket, then stainless-steel pail is used for all samples. If sample collector cannot retrieve a representative sample from bridge, using either bucket or pail, he/she may sample stream from stream bank subject to restrictions of paragraph II.A.6, above. The precise location of sampling point, and the sampling procedures actually used by employee, are recorded on field data recording sheet (Appendix C). The back of this sheet may be used to sketch location of sampling point in relation to bridge and to record other important details.
4. Prior to obtaining water samples from a given stream monitoring station, sample containers must be labeled and their corresponding identification numbers recorded on field data recording sheet (Appendix C). All recorded entries must be neat, legible and indelible to avoid confusion of samples during laboratory submission and analysis.
5. Sample containers are loaded into a pour rack fitted in a plastic tub to catch spillage. The lid is secured with lid nut on the weighted sample bucket. Four stainless-steel fill tubes are welded to, and extend down from, the detachable lid of bucket. This specialized lid protects sample from air borne particular matter during transport back to the field vehicle. All this work is conducted in sampling vehicle through open sliding/latching side door.
6. Walk to the sampling point on bridge, carrying coil of rope, weighted stainless-steel sampling bucket and stainless-steel sampling pail. Connect rope to bucket by attaching snap swivel at end of rope to nut on bucket (do not use bucket handle for lowering/retrieving bucket). Use rope to slowly lower sampling bucket over bridge railing and beneath surface of stream. Allow bucket to fill completely with stream water. Retrieve sampling bucket and detach rope. Reattach rope to handle of sampling pail and slowly lower pail over bridge railing and beneath surface of stream. Retrieve pail filled with stream water, and disengage rope. Carry bucket, pail and coiled rope back to sampling vehicle. (Note: If a radiological sample is being collected, a one-gallon radiological container is carried to sampling point on bridge and filled from pail before obtaining pesticide sample. The radiological sample is transferred to sampling vehicle with other samples.)
7. Upon return to vehicle, record time of sample collection on field data recording sheet. Pour pesticide sample into a one-gallon dark glass jug using stainless-steel funnel, and replace and securely tighten Teflon-lined cap on jug. Detach lid of weighted stainless-steel sampling bucket. Fill heavy metal sample container, mineral cubitainer, bacteria sample container, nutrient sample container, pH/temperature beaker, and dissolved oxygen bottle by carefully pouring water from bucket. The dissolved oxygen aliquot should be poured slowly and carefully to minimize aeration of sample. Between poured fractions, gently swirl sample bucket to facilitate mixing of sample. Replace caps on containers and tighten securely. Gently shake heavy metal

container and nutrient container to mix sample water and acid preservative. Replace cap on bacteria sample container; tighten securely but avoid touching neck and interior of container and inside of cap. Measure pH and temperature of sample (SCMP-003) and record values on field recording sheet. Preserve dissolved oxygen sample according to Winkler method (see below). Pack pesticide jug, mineral cubitainer, nutrient bottle and bacteriological bottle in chipped ice inside ice chest pending delivery to KDHE laboratory. Store heavy metal container and dissolved oxygen bottle in wooden storage flat, and position flat in a deeply shaded location (e.g., under dark towel, cardboard box, or inverted storage flat) pending delivery to KDHE laboratory. Detailed procedures for handling and preserving specific sample fractions are presented below.

C. Detailed Sample Preservation and Handling Procedures

1. Dissolved Oxygen Sample

- a. Fill dissolved oxygen (DO) bottle by pouring water from sampling bucket slowly and carefully to minimize sample aeration. Put on disposable polyethylene gloves and safety goggles (or other appropriate hand and eye protection) if not already in place.
- b. Add 2 ml of manganous sulfate to sample from Winkler DO kit. This reagent is contained in squeeze bottle labeled #1. (When using a squeeze bottle, force reagent into 2-ml dispensing pipette tip by gently squeezing bottle. Dispense reagent by inverting squeeze bottle while placing pipette tip just above surface of sample.)
- c. Add 2 ml of alkaline potassium iodide azide. The squeeze bottle containing this reagent is labeled #2.
- d. After reagents #1 and #2 have been added to DO bottle, close stopper and invert bottle 25 times for thorough mixing of reagents with sample. Set sample aside until floc has settled one-third of way down bottle. Floc will settle more rapidly in warmer samples than in colder samples.
- e. After floc has settled one-third of way down bottle, add 2 milliliters of concentrated sulfuric acid from squeeze bottle labeled #3.
- f. Replace stopper, rinse outside of bottle with de-ionized water, and invert bottle 25 times to break up floc and ensure thorough mixing of sample and reagents. Development of a dark brown color generally indicates a high amount of DO in sample, whereas a light amber or clear color indicates little or no DO. (Actual DO concentrations, in mg/L, are determined later by KDHE laboratory.)

- g. Place sample in wooden flat and store in deeply shaded area of van pending transfer to KDHE laboratory.

2. Nutrient Sample

- a. Fill nutrient bottle by pouring water directly from sampling bucket. Avoid overfilling, as bottle has been pre-acidified with sulfuric acid solution.
- b. Replace and securely tighten bottle cap. Gently shake bottle for about 10 seconds. Place nutrient sample in ice chest and pack in chipped ice pending transfer to KDHE inorganic chemistry laboratory.

3. Bacteriological Sample

- a. Fill bacteriological bottle by pouring water directly from sampling bucket. Avoid touching interior of bottle (careless handling may contaminate sample with bacteria from collector's hand).
- b. Shake off some of sample, leaving a 1-2 inch air space at top of bottle to allow for ready mixing of sample during laboratory analysis. Replace and securely tighten bottle cap, avoiding any contact with inside of cap or with interior of sample bottle. Pack sample bottle in chipped ice in ice chest pending delivery to KDHE bacteriology laboratory.

4. Heavy Metal Sample

- a. Fill heavy metal bottle by pouring water directly from sampling bucket. Avoid overfilling, as bottle has been pre-acidified with nitric acid solution. Leave a 1-2 inch air space to facilitate mixing of sample.
- b. Replace and securely tighten bottle cap. Gently shake bottle for about 10 seconds to thoroughly mix sample with acid preservative. Place sample in wooden flat. Store flat in secure location in vehicle pending transfer to KDHE inorganic laboratory.

5. Pesticide Sample

- a. Fill pesticide jug by pouring water directly from stainless-steel pail through stainless-steel funnel. Replace and securely tighten Teflon-lined plastic cap. (Note: Plastic containers or funnels should not be used for collecting/transferring pesticide samples, as organic compounds may leach from plastic and interfere with laboratory analyses.)

- b. Pack sealed pesticide jug in chipped ice in ice chest pending transfer to KDHE organic laboratory.

6. Radionuclide Sample

- a. Fill radionuclide container by pouring water directly from stainless-steel pail through stainless-steel funnel. Replace and securely tighten container cap.
- b. Store container in a secure location in vehicle during transport to KDHE radiological laboratory.

7. Volatile Organic Sample (special studies only)

- a. Prior to withdrawing VOC sample from stainless steel bucket or pail, record station name or number, collector's initials, and date of collection on label of vial.
- b. Immerse lip of vial slowly and carefully into sample, until vial gradually fills with water. Completely immerse vial in vertical position, and slowly lift from water so that a bead of water rises above opening of vial.
- c. Float Teflon-lined septum (cap liner) on top of meniscus, ensuring that Teflon side (thin white side) is in contact with water.
- d. Replace cap on vial carefully and tightly. Turn vial upside down, tap lightly, and observe for any air bubbles. If bubbles are present, empty vial, flush with sample water, repeat steps b-c, above, and recheck for bubbles.
- e. Pack vial in chipped ice in ice chest pending transport to laboratory.

8. Temperature and pH Measurements

- a. Fill 50-ml beaker with 30-40 ml of sample water by pouring directly from stainless-steel sampling pail. Immediately insert tip of thermometer into sample, wait 10-20 seconds for equilibration, record sample temperature (to the nearest °C) on field data recording sheet, and withdraw thermometer.
- b. After pH meter has been properly calibrated and standardized (SCMP-003), place probe in beaker, compensate for sample temperature, gently stir probe until pH reading stabilizes, and record stable reading on field data reporting sheet.

FIELD CHAIN-OF-CUSTODY PROCEDURES FOR STREAM WATER SAMPLES (SCMP-006)

I. INTRODUCTION

A. Purpose

Surface water quality data derived from the stream chemistry monitoring program may be used in agency enforcement actions or in other regulatory endeavors. Field staff involved in sample collection must ensure that water quality samples are maintained in a secure and appropriate setting and that the transfer of samples to appropriate laboratory personnel, and any intermediaries, is accurately and permanently documented. The following paragraphs describe procedures used in the stream chemistry monitoring program for relinquishing and receiving water quality samples and for ensuring their security and integrity from the moment of collection to the time of transfer to laboratory personnel.

B. Minimum Staff Qualifications

Personnel implementing this SOP should meet the minimum classification requirements for environmental technician II published by the Kansas Department of Administration. They also should be experienced in the measurement of the physicochemical and microbiological properties of surface water and in the performance of environmental field investigations.

II. PROCEDURES

- A.** All samples submitted to KHEL for analysis must be accompanied by an appropriate sample submission form (Appendix C). This includes water quality samples for minerals, nutrients, heavy metals, bacteriology, pesticides, radionuclides, and any sediment samples or other special samples analyzed by KHEL.
- B.** At the bottom of each sample submission form are fields for chain-of-custody. The first field is signed by one member of the field crew that collected the samples in question. On the date the samples are delivered to KHEL, this person must sign/date the first chain-of-custody field using indelible ink. Upon delivery, staff of KHEL will accept the samples and sign/date the second chain-of-custody field, again using indelible ink. This provides a record of custody from the time of collection to the time of arrival at KHEL.
- C.** Photocopies of sample submission forms are made at the laboratory immediately after signatures are obtained. The original forms are retained by field staff for routing to the program manager or his/her designee. Photocopies are retained by the laboratory employee receiving the samples.

- D. In the event samples pass through an intermediate transfer en route to the laboratory (e.g., relinquishing of samples from district staff to program staff), additional chain-of-custody fields are filled out on the sample submission forms. The KHEL forms supply three sets of fields on each form. Each time a person accepts or relinquishes responsibility for the samples, he/she must fill out a chain-of-custody field on each separate submission form.
- E. Forms completed in the field contain important empirical data and supporting documentation. Loss of these forms, or any accident which would impair their legibility, would result in a significant loss of data and could necessitate a return trip to the stream(s) in question. Hence, it is imperative that care be taken by staff in the handling, filing and eventual archiving of these documents. Similar considerations apply to any photographs or other forms of documentation obtained during the course of field activities.

PROCEDURES FOR FIELD BLANK SAMPLES (SCMP-007)

I. INTRODUCTION

A. Purpose

Unless closely monitored and controlled, the inadvertent contamination of samples during collection, preservation, transport, storage, processing and/or analysis may lead to erroneous conclusions about the quality of the environment. Field blanks provide one means of assessing and quantifying the overall extent of sample contamination. The following paragraphs set forth those procedures for preparing field blanks utilized in the stream chemistry monitoring program.

B. Minimum Staff Qualifications

Personnel implementing this SOP should meet the minimum classification requirements for environmental technician II published by the Kansas Department of Administration. They also should be experienced in the measurement of the physicochemical and microbiological properties of surface water and in the performance of environmental field investigations.

C. Equipment/Accessories

1. All items listed in Appendix A
2. Plastic jug (1 gal) filled ASTM Type-I quality water
3. Dark glass jug (1 gal) filled with ASTM Type-I quality water

II. PROCEDURES

A. Preparation of Field Blanks for Inorganic and Bacteriological Sample Fractions

1. Prior to sampling run, fill one-gallon plastic container with ASTM Type-I quality water at KDHE inorganic laboratory. Replace and securely tighten cap. Transport container in sampling vehicle to selected stream monitoring location. Upon arrival, and following completion of regular sampling and field measurement activities (SCMP-005), fill stainless-steel self-filling bucket with de-ionized water by pouring directly from one-gallon jug.
2. Place lid on sample bucket and secure with nut. Gently swirl bucket for about 20 seconds to simulate motion during normal stream sampling procedure. Remove nut and lid of bucket and pour into sample containers. Between poured fractions, gently swirl sample bucket to facilitate mixing of sample.

3. Prepare and transport blank mineral, nutrient, heavy metal and bacteriological sample fractions, and perform pH and temperature measurements, according to procedures for regular stream water samples given in SCMP-005, section II.C.

B. Preparation of Field Blanks for Pesticide Sample Fraction

1. Prior to sampling run, fill one-gallon dark glass jug with ASTM Type-I quality water at KDHE inorganic laboratory. Replace and securely tighten cap. Transport in sampling vehicle to selected stream monitoring location. Upon arrival, and following completion of regular sampling and field measurement activities (SCMP-005), fill stainless-steel pail with de-ionized water by pouring directly from one-gallon jug.
2. Gently swirl pail for about 20 seconds to simulate motion during normal stream sampling procedure.
3. Prepare and transport blank pesticide sample fraction according to procedures for regular stream water samples given in SCMP-005, section II.C.

C. Field Blank Laboratory Identification Codes and Related Considerations

1. Assign blank sample a laboratory identification code of SC000 on field data recording sheet. Record sample "collection" time, equaling that of previous regular sample plus five minutes, on field data recording sheet. (This five-minute time separation will be used, along with identification code, to designate sample as a field blank in Kansas Water Database).
2. Along with other data recorded for blank sample on field data recording sheet, indicate name and number of monitoring station sampled prior to preparation of field blank (to provide an indication of contaminant carry-over from sample to sample.)

PROCEDURES FOR FIELD DUPLICATE AND REPLICATE SAMPLES (SCMP-008)

I. INTRODUCTION

A. Purpose

Field duplicate and replicate samples provide a combined measure of natural sample variability and the variability inherent in sampling and analytical efforts. They allow estimates of data precision to be obtained and incorporated into statistical measures of surface water quality. The following text outlines those procedures used in the stream chemistry monitoring program for the collection and handling of duplicate and replicate stream water samples.

B. Minimum Staff Qualifications

Personnel implementing this SOP should meet the minimum classification requirements for environmental technician II published by the Kansas Department of Administration. They also should be experienced in the measurement of the physicochemical and microbiological properties of surface water and in the performance of environmental field investigations.

C. Equipment/Accessories

See Appendix A.

II. PROCEDURES

1. Follow procedures described in SOP No. SCMP-005 for collection and preservation of water samples and performance of preliminary field measurements.
2. Before leaving stream chemistry monitoring station, generate another (duplicate) set of samples/measurements by repeating all above procedures.
3. If additional (replicate) sets of samples/measurements are desired, repeat the above procedures as many times as needed.
4. Record a five-minute time differential between successive sets of samples/measurements. This time interval will designate the samples as duplicate or replicate samples in the Kansas Water Database.

PROCEDURES FOR FIELD SPIKED SAMPLES (SCMP-009)

I. INTRODUCTION

A. Purpose

The following paragraphs describe those procedures used in the stream chemistry monitoring program for field spiking water samples with known concentrations of selected chemical parameters. Measured levels of these parameters in spiked samples are compared to those in unamended duplicate samples to provide an overall indication of sample degradation and analytical recovery. Field spikes provide one means of quantifying the accuracy of water quality data.

B. Minimum Staff Qualifications

Personnel implementing this SOP should meet the minimum classification requirements for environmental technician II published by the Kansas Department of Administration. They also should be experienced in the measurement of the physicochemical and microbiological properties of surface water and in the performance of environmental field investigations.

C. Equipment/Accessories

1. All items listed in Appendix A
2. Stainless-steel pail (3 gal)
3. Trace metal/metalloid reference solution
4. Cation reference solution
5. Anion reference solution
6. Nutrient-1 reference solution
7. Nutrient-2 reference solution
8. Pesticide reference solution
9. Graduated cylinder, 1-liter, glass, with enlarged plastic stopper
10. Graduated cylinder, 2-liter, glass, with enlarged plastic stopper (2)
11. Brinkmann Eppendorf pipette, fixed volume, 1000 μL
12. Brinkmann Eppendorf pipette, adjustable volume, 100-1000 μL
13. Brinkmann Eppendorf pipette tips
14. Pasteur pipette, disposable borosilicate glass, 5-3/4"
15. Plastic jug, one-gallon, filled with ASTM Type-I quality water

II. PROCEDURES

A. Overview of Field Spike Procedures

Follow procedures in SOP No. SCMP-005 for collection and preservation of water quality samples, with following modifications.

1. Carry three-gallon (rather than one-gallon) stainless-steel pail to sampling location on bridge. Attach pail to rope by connecting snap swivel at end of rope to bucket handle. Lower pail over bridge railing and beneath surface of stream. Allow pail to fill completely. If stream is too shallow to submerge three-gallon pail in an upright position, use one-gallon pail to fill larger pail, pouring water slowly to minimize aeration of sample.
2. Transport three-gallon pail with sample to field vehicle. Immediately fill sampling containers and graduated cylinders needed for organic sample fraction (see below). Swirl pail gently before each pour to minimize settling of any suspended materials.
3. Repeat step (2), above. Transport three-gallon pail with sample to field vehicle. Immediately fill sampling containers and graduated cylinders needed for inorganic sample fraction (see below). Swirl pail gently before each pour to minimize settling of suspended materials. Measure water temperature and pH as described in (SCMP-004). Sample containers that have no spike additions (DO and bacteriological) are filled and preserved as described in (SCMP-005.II..B-C).
4. The laboratory identification code for all field-spiked fractions is recorded as SC999. Time of collection for all field-spiked fractions is recorded as five minutes after collection of regular sample. The code and five-minute time differential are used to signify a field-spiked sample in the Kansas Water Database .

B. Specific Field Spike Procedures

1. Pesticide (Organic) Spike
 - a. Rinse a two-liter graduated cylinder with sample water by pouring water from three-gallon stainless-steel pail through stainless-steel funnel. Discard rinse water and refill two-liter cylinder to 2000-ml mark (read bottom of meniscus formed when sample water wets cylinder wall). Transfer contents into a one-gallon dark glass jug using funnel. Refill two-liter cylinder to 2000-ml mark reading meniscus.
 - b. Use funnel and remaining water in sampling pail to completely fill another one-gallon dark glass jug. Replace cap and tighten securely. This jug contains unamended pesticide sample.
 - c. Invert pesticide ampule several times to mix. Open ampule by carefully snapping at score line. Transfer contents (certified reference solution, 1-ml) into jug containing 2000 ml of sample water. Using

a Pasteur pipette, rinse ampule three times with sample water from two-liter cylinder, transferring each rinse to jug. Pour remaining water in two-liter cylinder into jug using funnel. Replace Teflon-lined plastic cap and tighten securely. Mix contents of jug by inverting several times. This jug contains amended (spiked) pesticide sample.

- d. Rinse two-liter cylinder three times with de-ionized water, discard rinse water, and store cylinder with other supplies for transport. Pack amended and unamended pesticide sample containers in chipped ice and store inside ice chest pending delivery to KDHE organic laboratory.

2. Combined Trace Metal and Cation Spike

- a. Rinse one-liter graduated cylinder by pouring water into cylinder from three-gallon stainless-steel pail through stainless-steel funnel. Discard rinse water. Pour a predetermined volume of sample water into rinsed one-liter cylinder using funnel. (Note: This volume is calculated prior to sampling run by program manager based on targeted spike amendment, which varies from run to run)
- b. Pour remaining sample water from sampling pail directly into heavy metal bottle. This bottle contains unamended heavy metal sample.
- c. Invert ampule marked “trace metals” several times to mix. Unscrew cap from ampule and transfer predetermined amount of ampule contents (trace metal reference solution) into one-liter cylinder using adjustable Eppendorf pipette.
- d. Invert ampule marked “cations” several times to mix. Unscrew cap from ampule and transfer predetermined amount of ampule contents (cation reference solution) into one-liter cylinder using adjustable Eppendorf pipette.
- e. Cap cylinder with plastic stopper and invert ten times to mix. Transfer contents of cylinder into heavy metal sample bottle. This bottle contains amended (spiked) heavy metal sample.

- f. Rinse one-liter cylinder three times with de-ionized water, discard rinse water, and store cylinder with other supplies for transport. Gently shake both heavy metal bottles approximately ten seconds to ensure thorough mixing of sample and preservative. Place bottles in wooden flat and store in secure area of sampling vehicle pending delivery to KDHE laboratory.

3. Nutrient and Anion Spikes

- a. Rinse two-liter graduated cylinder by pouring water into cylinder from three-gallon stainless-steel pail through stainless-steel funnel. Discard rinse water. Pour a predetermined volume of sample water into two-liter cylinder using funnel.
- b. Apportion remaining sample water among mineral container (one-quart cubitainer) and nutrient bottle, pouring directly from pail through funnel. Cubitainer and bottle contain unamended mineral sample and unamended nutrient sample, respectively.
- c. Invert ampule marked “anions” several times to mix. Unscrew cap from ampule and transfer predetermined amount of contents (anion reference solution) into two-liter cylinder using adjustable Eppendorf pipette.
- d. Invert ampule marked “nutrient-1” several times to mix. Unscrew cap from ampule and transfer predetermined amount of contents (anion reference solution) into two-liter cylinder using adjustable Eppendorf pipette. (Note: This same cylinder is referenced in steps a and c, above.) Cap cylinder with plastic stopper and invert ten times to mix contents.
- e. Apportion contents of cylinder among mineral cubitainer and nutrient bottle. Cubitainer and bottle contain amended mineral sample and amended nutrient (ammonia-N) sample, respectively.
- f. Invert ampule marked “nutrient-2” several times to mix. Unscrew cap from ampule and transfer predetermined volume of contents (Kjeldahl-nitrogen reference solution) into a clean, two-liter graduated cylinder using adjustable Eppendorf pipette with clean (unused) pipette tip. Cap cylinder with plastic stopper and invert ten times to mix.
- g. Transfer 175 ml from cylinder referenced in step f, above, into clean nutrient bottle. Bottle contains amended nutrient (Kjeldahl-N) sample.

- h. **Caution:** If ammonia-nitrogen and Kjeldahl-nitrogen field spikes are prepared on same stream monitoring run, and at same stream monitoring station, then care must be taken to dilute contents of nitrogen-1 (ammonia-nitrogen) ampule and nitrogen-2 (Kjeldahl-nitrogen) ampule in different graduated cylinders and to transfer resulting solutions into different nutrient bottles.
- i. Add 2 ml of 1:30 (v:v) sulfuric acid solution (reagent #4) to all amended (spiked) and unamended nutrient samples. Replace and securely tighten bottle caps. Gently shake each bottle for about 10 seconds to ensure complete mixing of sample, any added nutrients, and acid preservative.
- j. Rinse both two-liter graduated cylinders three times with de-ionized water, discard rinse water, and store cylinders with other supplies for transport. Pack all mineral sample cubitainers and nutrient sample bottles in chipped ice inside ice chest. Store ice chest in secure location in sampling vehicle pending transport to KDHE inorganic laboratory.

APPENDIX C

STANDARDIZED FIELD SHEETS AND

SAMPLE SUBMISSION FORMS

TABLE OF CONTENTS

<u>Form</u>	<u>Revision</u> <u>No.</u>	<u>Date</u>
Inorganic Laboratory Sample Submission Form with Chain-of-Custody Block (Form APP.C-1)	0	12/1/00
Bacteriological Laboratory Sample Submission Form with Chain-of- Custody Block (Form APP.C-2)	0	12/1/00
Organic Laboratory Sample Submission Form with Chain-of-Custody Block (Form APP.C-3)	0	12/1/00
Radiological Laboratory Sample Submission Form with Chain-of-Custody Block (Form APP.C-4)	0	12/1/00

FORM APP.C-1

INORGANIC LABORATORY SAMPLE SUBMISSION

FORM WITH CHAIN-OF-CUSTODY BLOCK

INORGANIC FIELD SHEET		KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT DIVISION OF ENVIRONMENT DATA FORM						COLLECTOR(S): _____ COLLECTION DATE: _____ DATE RECEIVED: _____							
PROJECT OR LOCATION: _____								BOTTLE NUMBERS							REMARKS <u>USE APPROPRIATE CODES</u> Flow: L = low, A = average, H = high, P = pooled, D = dry Water Condition: C = clear, RO = run off, T = turbid, GC = green cast, BC = brown cast, GBC = grey to black cast
NETWORK STATION NO. AND RIVER OR CREEK LOC.	LAB I.D. NO.	O. C.	SAMPLE I.D. NO.	TIME	ORGA- NICS	RAD HEALTH	HEAVY METALS	DO	CHEM & BOD	BACT	NH3	TEMP C	FIELD pH		

DATE RECEIVED: _____

CHAIN OF CUSTODY
 RECEIVED FROM: _____

 TIME RECEIVED : _____

RECEIVED BY: _____

ORGANIC USE ONLY: _____

REPORT TO: BEFS, Forbes Field, Bldg. 283	PROGRAM CODE: SC	OC ANALYSIS CODES: PX,HX
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FORM APP.C-2

BACTERIOLOGICAL LABORATORY SAMPLE SUBMISSION FORM WITH CHAIN-OF-CUSTODY BLOCK

[illegible]

ORGANIC LABORATORY SAMPLE SUBMISSION FORM WITH CHAIN-OF-CUSTODY BLOCK

ORGANIC FIELD SHEET PROJECT OR LOCATION: _____		KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT DIVISION OF ENVIRONMENT DATA FORM						COLLECTOR(S): _____ COLLECTION DATE: _____ DATE RECEIVED: _____						
NETWORK STATION NO. AND RIVER OR CREEK LOC.	LAB I.D. NO.	O. C.	SAMPLE I.D. NO.	TIME	ORGA- NICS	RAD HEALTH	BOTTLE NUMBERS					TEMP C	FIELD pH	REMARKS USE APPROPRIATE CODES Flow: L = low, A = average, H = high, P = pooled, D = dry Water Condition: C = clear, RO = run off, T = turbid, GC = green cast, BC = brown cast, GBC = grey to black cast
							HEAVY METALS	DO	CHEM & BOD	BACT	NH3			

DATE RECEIVED: _____

CHAIN OF CUSTODY
 RECEIVED FROM: _____

RECEIVED BY: _____

ORGANIC USE ONLY: _____

TIME RECEIVED: _____

REPORT TO: BEFS, Forbes Field, Bldg. 283	PROGRAM CODE: SC	OC ANALYSIS CODES: PX, HX
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FORM APP.C-4

RADIOLOGICAL LABORATORY SAMPLE SUBMISSION
FORM WITH CHAIN-OF-CUSTODY BLOCK

KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT

COLLECTOR: _____ REPORT TO: _____

COLLECTOR'S PHONE NUMBER: _____

DATE COLLECTED: _____

ACCT. CODE: WC _____ RT _____ UR _____ SC _____

SUBMITTED BY: _____

	SAMPLE ID (18 Char. Max)	LOCATION	BOTTLE NUMBER	TIME COLLECTED	TYPE	ANALYSIS
A			Gallon		03	As Per Scheduled
B			Gallon		03	As Per Scheduled
C			Gallon		03	As Per Scheduled
D			Gallon		03	As Per Scheduled
E			Gallon		03	As Per Scheduled

	LABORATORY NO.	DATE REC'D	REC'D BY	GAMMA SCAN
A				
B				
C				
D				
E				

REMARKS:

APPENDIX D

GLOSSARY OF TERMS

GLOSSARY OF TERMS

accuracy -- the extent to which a measured value actually represents the condition being measured. Accuracy is influenced by the degree of random error (precision) and systematic error (bias) inherent in the measurement operation (e.g., environmental sampling and analytical operations).

activity -- an all inclusive term describing a specific set of operations or related tasks to be performed, either serially or in parallel (e.g., research and development, field sampling, analytical operations), that in total result in a product or service.

assessment -- the evaluation process used to measure the performance or effectiveness of a system and its elements. As used in this program QA management plan, "assessment" is an all-inclusive term used to denote audits, performance evaluations, management system reviews, internal reviews and related actions.

audit -- a systematic and independent examination to determine whether quality activities and related results comply with planned arrangements and whether these arrangements are implemented effectively and are suitable to achieve objectives.

bias -- the systematic or persistent distortion of a measurement process which causes errors in one direction (i.e., the degree to which the expected sample measurement is different from the true sample value).

calibration -- a comparison of a measurement standard, instrument, or item with a standard, instrument or item of higher accuracy to detect, quantify and report inaccuracies and to eliminate these inaccuracies through adjustments.

chain of custody -- an unbroken trail of accountability that ensures the physical security of samples, data and records.

comparability -- a measure of the confidence with which one item (e.g., data set) can be compared to another.

completeness -- a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions.

computer program -- a sequence of instructions suitable for processing by a computer. Processing may include the use of an assembler, compiler, interpreter, or translator to prepare the program for execution. A computer program may be stored on electrical, magnetic or optical media.

corrective action -- any measure taken to rectify a condition adverse to quality and, if possible, to preclude its recurrence.

data performance criteria -- qualitative and quantitative statements that define the appropriate type of data and/or specify tolerable levels of potential decision errors used as the basis for establishing the quality and quantity of data needed to support decisions.

data quality assessment -- a scientific and statistical evaluation of a set of environmental data to determine the adequacy of the data for its intended use.

deficiency -- an unauthorized deviation from acceptable procedures or practices.

detection limit -- the lowest concentration of a target analyte that a given method or instrument can reliably ascertain and report as greater than zero.

document -- any written or pictorial information describing, defining, specifying, reporting or certifying activities, requirements, procedures or results.

duplicate samples -- paired samples collected at essentially the same time from the same site and carried through all assessment and analytical procedures in an identical manner. Duplicate samples are used to measure natural variability as well as the precision of a method, monitoring instrument, and/or analyst. More than two such samples are referred to as replicate samples.

ecoregion -- an ecologically distinctive geographical area, defined in the context of scale by a combination of landscape features such as climate, physiography, soils, vegetation or potential vegetation, geology, and land use.

environmental data -- the description of a physical medium (e.g., air, water, soil, sediment) or biological system expressed in terms of some measurable physical, chemical, radiological or biological characteristic or set of characteristics.

environmental monitoring program -- a planned and systematic operation for characterizing an environmental process or condition. For the purposes of this program QA, the term “program” refers to a major, ongoing or longer term environmental monitoring operation.

environmental monitoring project -- a planned and systematic operation for characterizing an environmental process or condition. For the purposes of this program QA management plan, the term “project” refers to a smaller scale or shorter term environmental monitoring operation.

field blank -- a clean sample (e.g., distilled water) that is otherwise treated the same as other samples collected in the field. Field blanks are submitted to the analyst along with other samples and are used to detect any contaminants that may be introduced during sample collection, storage, analysis and transport.

field spike -- a spiked sample prepared in the field. See spiked sample.

holding time -- an agreed upon, maximum interval of time in which a sample can be held under prescribed preservation methods.

independent assessment -- a quality assessment of an environmental monitoring program, project or system performed by a qualified individual, group, or organization that is not part of the program, project or system.

inspection -- examination or measurement of an activity to verify conformance with specific requirements.

internal assessment -- any quality assessment of the work performed by an individual, group, or organization, conducted by those overseeing and/or performing the work.

method -- a body of procedures for performing an activity in a systematic and repeatable manner.

nonparametric statistics -- procedures for organizing and interpreting numerical data that are free of any assumptions about the data distribution and do not require estimation of the variance, mean or other population parameters.

parametric statistics -- procedures for organizing and interpreting numerical data that employ certain assumptions about the data distribution and require estimation of at least one population parameter.

peer review -- a critical review of a finding or document conducted by qualified individuals other than those who produced the finding or document but collectively equivalent in technical expertise.

performance evaluation -- a type of audit in which the quantitative data generated in a measurement system are obtained independently and compared with routinely obtained data to evaluate the proficiency of a technician, analyst or laboratory.

precision -- the level of agreement among individual measurements of the same property, conducted under identical or similar conditions.

qualified data -- data that have been modified, adjusted or flagged in a data base following data validation and verification procedures.

quality -- those features of a product or service that bear on its ability to meet the stated or implied needs and expectations of the user.

quality assurance (QA) -- an integrated system of management activities involving planning, implementation, assessment, reporting, and quality improvement to ensure that a process, item or service is of the type and quality needed and expected by the user.

quality control (QC) -- the overall system of technical activities that measures the attributes and performance of a process, item or service against defined standards to verify that they meet the stated requirements of the user.

quality management plan (QMP) -- a formal document that describes a quality management system in terms of the organizational structure, functional responsibilities, and planning, implementation and assessment of work.

record -- a document or portion thereof furnishing evidence of the quality of an item or activity, verified and authenticated as technically complete and correct. Records may include reports, photographs, drawings, and data stored on electronic, magnetic, optical or other recording media.

reference site -- a monitored site (e.g., stream location or segment) that is little impacted by urban, industrial or agricultural development or any other human enterprise. Reference sites serve as points of comparison for assessing the extent of human impact on the ecological integrity of other sites in the same ecoregion.

replicate sample -- see duplicate sample.

reporting limit -- the lowest (or highest) concentration (or level) of a parameter that can be reliably reported by an individual analyst or laboratory based on the applied analytical method and instrumentation, the ability of the analyst or laboratory, and the effort devoted to the analytical determination.

representativeness -- a measure of the degree to which data accurately and precisely represent a selected characteristic of a monitored system.

reproducibility -- a measure of the degree to which sequential or repeated measurements of the same system vary from one another, independently of any actual change in the system.

sensitivity -- a measure of the capacity of an analytical method or instrument to discriminate between different levels of a variable of interest.

spiked sample -- a sample of water, air, soil, sediment, biological tissue or other material which is amended by the addition of a known amount of a given chemical element or compound. The measured concentration of the element or compound in the amended material is compared to the measured amount in the unamended material to provide a measure of analytical recovery and accuracy.

standard operating procedure (SOP) -- a written, formally approved document that comprehensively and sequentially describes the methods employed in a routine operation, analysis or action.

technical review -- a critical review of an operation by independent reviewers collectively equivalent in technical expertise to those performing the operation.

thalweg – a line defining the lowest points along the length of a stream bed or valley.

total maximum daily load (TMDL) – an estimate of the maximum quantity of a given pollutant that may be added to a surface water body from all sources without violating established water quality criteria, minus a margin of error that accounts for, and corresponds to, the statistical uncertainty inherent in the loading estimate.

validation -- the establishment of a conclusion based on detailed evidence or by demonstration. This term is often used in conjunction with formal legal or official actions.

APPENDIX E

REFERENCES

REFERENCES

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